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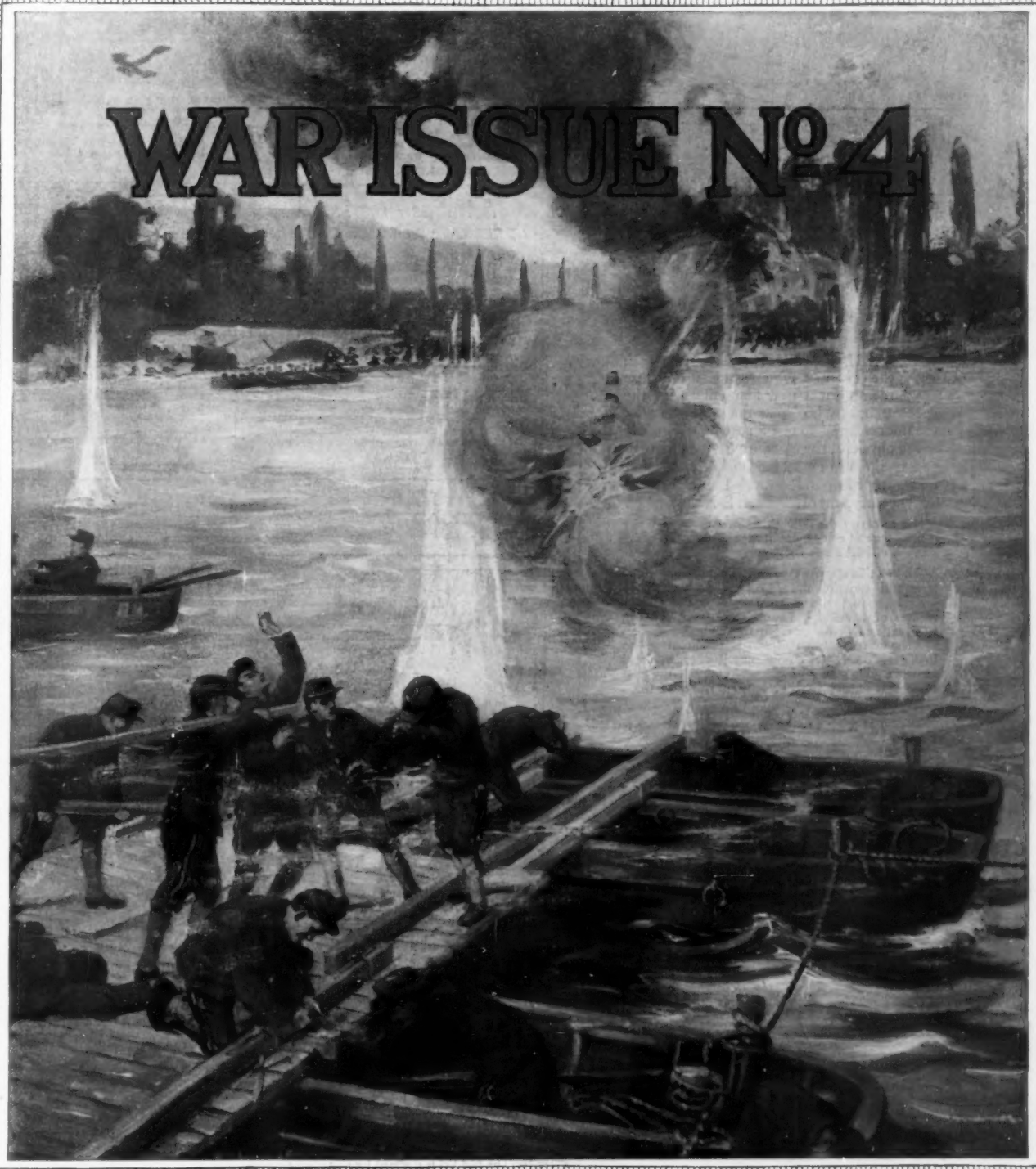

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Vol. CXI. No. 23
December 5, 1914

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VOLUME CXI. NUMBER 23

NEW YORK, DECEMBER 5, 1914

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The Action in Which the "Carmania" Sank the "Cap Trafalgar"

EARLY in the forenoon of Monday, September 14th, the auxiliary cruiser "Carmania," formerly a popular passenger vessel of the Cunard Line, observed the island of Trinidad ahead and altered course to pass close to the west extremity. Shortly after 11 A. M. she made out a vessel off the western end of the island, and, later, saw that there were three steamers, one a large liner, the others colliers. The latter had derricks topped, and they were probably working when the "Carmania" hove in sight.

Before she had raised their hulls above the horizon, the ships had separated and were making off in different directions. The large vessel was apparently of about the same size as the "Carmania," and her two funnels were painted to resemble a British liner of the Castle Line.

After running away for a little while, the large steamer, which eventually proved to be the German liner "Cap Trafalgar," turned to starboard and headed toward the "Carmania." The weather was fine, with a moderate breeze. The speed of the "Carmania" was 16 knots and that of the "Cap Trafalgar" about 18 knots.

At 8,500 yards, the "Carmania" fired a shot across the bows of the enemy, and he immediately opened fire from his starboard after gun. The "Carmania" replied with all her port guns and the firing became general. The ships were now well within range, and, as most of the enemy's shots were going over, the "Carmania's" rigging, masts, funnels, derricks, and ventilators all suffered. The "Cap Trafalgar" was then well opened on the "Carmania's" port side, and all of the starboard and port guns of the respective ships were firing rapidly.

Owing to the decreasing range, the machine guns of the "Cap Trafalgar" were becoming particularly dangerous; so the "Carmania" was turned away from him and the range opened.

Two of the "Carmania's" hits were seen to disable the enemy's deck steampipes, and it was noticed that he was well on fire forward and had a slight list to starboard.

At this time one of the "Cap Trafalgar's" shells passed though the "Carmania's" cabin under the fore bridge, and, although it did not burst, it started a fire which increased rapidly, no water being available owing to the fire main having been shot through, and the chemical fire extinguishers proving of very little use. The fire got such a firm hold that the fore bridge had to be abandoned, and the ship had to be fought from the after bridge, the lower steering position being used.

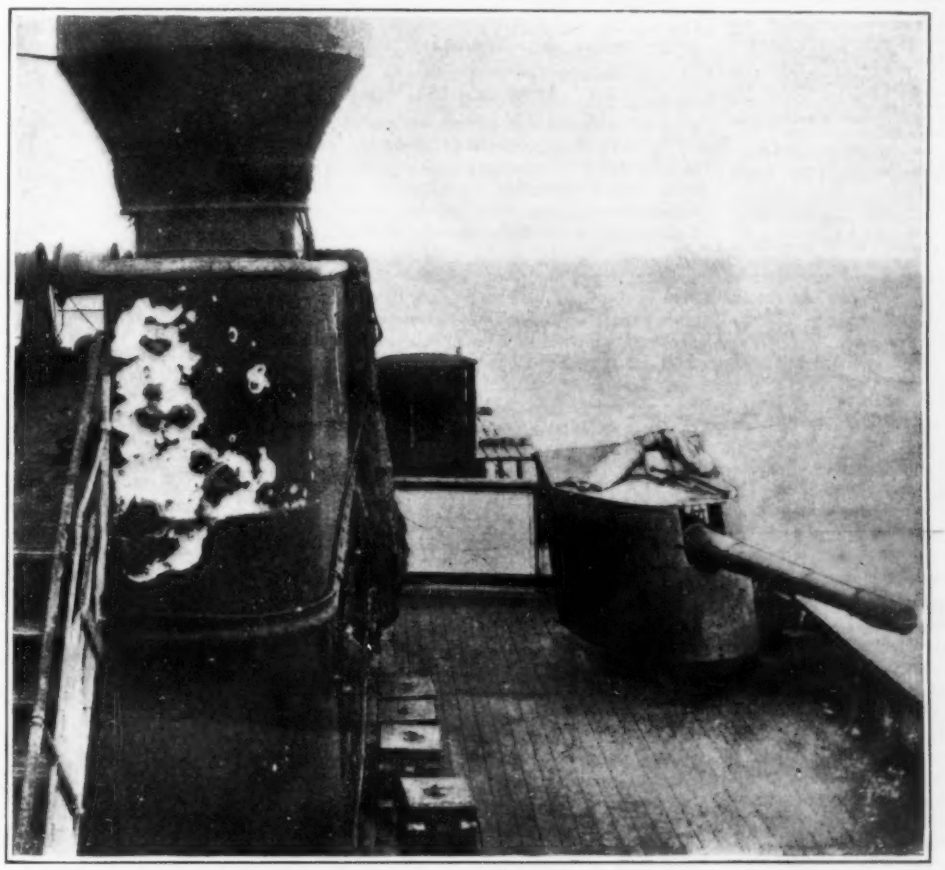
By this time the "Cap Trafalgar" was on the starboard bow of the "Carmania" and showed a heavy list to starboard; and at 1:50 P. M., or one hour and forty minutes from the firing of the first shot, she capsized to starboard and went down bows first, with colors flying.

It was some time before the fire was got under control and it was only possible to do this by keeping the ship before the wind. Consequently, the "Carmania" could not go to the assistance of the survivors, some of whom got away in boats and were picked up by one of the colliers.

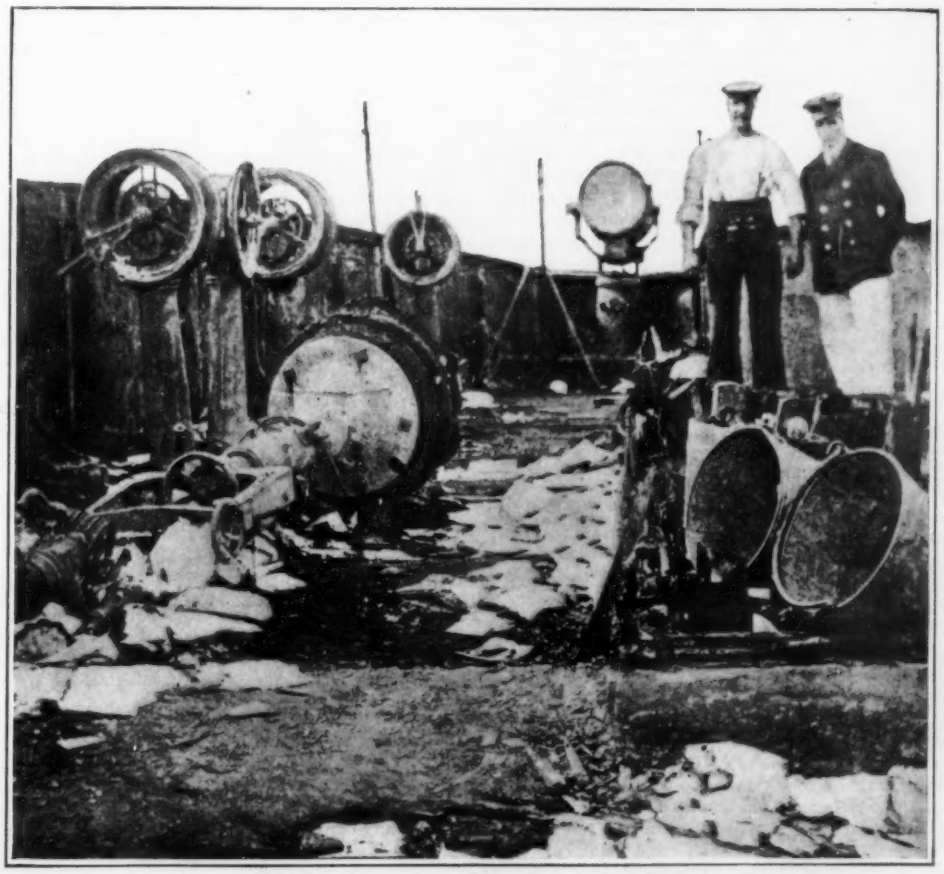
The enemy, before sinking, was in wireless communication with some German vessel; and, as smoke was seen on the northern horizon, and the signal man thought he could make out a cruiser's funnels, the "Carmania" made off at full speed to the southward, altering course at dusk for Abrolhus Rocks. The ship was by this time in touch with the cruiser "Cornwall," and asked him to meet her, as the ship was unseaworthy, and practically all communications and navigational instruments on the bridge had been destroyed by the enemy's fire, rendering the conning and navigation of the ship difficult and uncertain.

On the 15th, at 4:30 P. M., the cruiser "Bristol" picked up the "Carmania" and escorted her until she was relieved by the "Cornwall," which took the "Carmania" on to Abrolhus Rocks, where the ship anchored to effect temporary repairs. The "Cap Trafalgar" was armed with 4-inch guns and the "Carmania" with either 4-inch or 4.7-inch.

The "Cap Trafalgar" directed her fire at the bridge and upper works of the "Carmania," seeking thus to put her out of action; the "Carmania," on the other hand, directed her fire at the water-line of the "Cap Trafalgar," destroying her stability and causing her to heel over and go down.



After bridge of "Carmania," showing one of her rapid-fire guns.



Wreckage on the bridge of the "Carmania."

THE ACTION IN WHICH THE "CARMANIA" SANK THE "CAP TRAFALGAR"

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.

The Silent War

ONE of the great surprises of the war, at least for the general public, has been the complete inactivity of the battleships and battle-cruisers of Great Britain and Germany. When war was declared, and the mighty fleet which had just been reviewed by King George disappeared suddenly to the eastward, the world awaited with breathless interest the first tidings of that long-talked-of battle between dreadnoughts, which was now, apparently, about to be fought somewhere in the North Sea.

Though the war is now over four months old, the public is still awaiting that Homeric contest; and the way things are going, it will be many months, and possibly two or three years, before the rival battleships line up against each other for a decisive fleet engagement—if indeed that engagement ever takes place.

When we bear in mind the enormous size and strength of the two navies, it will be seen that such cruiser and submarine actions as have occurred must be regarded as mere outpost affairs, which have had practically no effect upon the first-line fighting strength, either of Great Britain or Germany. The dreadnoughts of the two navies total together nearly half a hundred ships. For four months they have been within a few hours steaming of each other and keyed up to the highest pitch of fighting efficiency. Yet in all this time not a single gun has spoken!

To the naval strategist this silence is the token of a victory as complete as any that could be won by the shock of 12-inch salvos and the wrecking of armor belts, turrets and barbettes; for it is the unspoken evidence of the persistent, remorseless pressure of the most remarkable blockade in all the history of naval warfare.

Incidentally, this silent victory is a striking example of the controlling, the absolutely decisive advantage conferred upon the nation which obtains the complete command of the sea—a subject which for many years past has formed the principal theme of the lectures and writings of our own Capt. Mahan.

The command of the sea! Let us consider what the acceptance of the blockade of her main fighting fleet has meant to Germany.

In the first place, it has resulted in the complete disappearance from all the seven seas of her vast merchant marine, such of her ships as escaped capture having fled to neutral ports or to her own protected bases on the North Sea and the Baltic. Her colonial possessions, in the acquisition and upbuilding of which she has expended so much energy and treasure, being absolutely cut off from any military or naval assistance, have passed one by one to the enemy. Her warships on foreign stations, after a series of exploits in commerce destroying and engagements with the enemy, which will form one of the brightest chapters in the history of her navy, are being gradually sunk or driven into neutral ports. Finally, her oversea trade, except through a few neutral ports, has ceased to exist.

But it is not in these respects that the silent victory of the war is making its pressure most keenly felt in this life-and-death struggle of the great German Empire. It is in its bearing upon the military operations in France and Belgium that the British command of the sea is exercising an influence, so dominant that it already promises to be the decisive factor in the whole situation.

Had the conditions been reversed; had the German fleet been superior in strength; or had the weaker fleet, by virtue of its superior *materiel*, personnel, strategy and tactics, been able to defeat the British and French in a series of decisive engagements, not a single regiment of British troops could have been sent to the western theater of war.

As it is, the enemy's troopships come and go with absolute impunity, while within a few hundred miles, the second strongest battleship fleet in the world lies impotently at anchor and watches the gradual recruiting, training, and transportation to the fighting line of some two million armed troops of the enemy, without being able to strike a blow to assist the valiant German army of the west.

Herein is a lesson in the value of the command of the sea, the moral of which we of the great Republic of the Western Hemisphere should lay well to heart.

Arms and the Man

AMONG the unexpected developments of the war, none has been more amazing than the unflinching steadiness with which the citizen soldiers of the warring nations, and especially those engaged on the western battlefields, have faced the murderous attack of modern weapons, whether by the magazine rifle, the machine gun, the searching shrapnel, or the shattering, high-explosive, 16-inch shell!

So accustomed have we become, through the daily testimony of eyewitnesses, to the more-than-human courage with which frail flesh and blood is facing, day in, day out, and for weeks together, the tornado of lead and steel which sweeps over the modern battlefield, that we are forgetting that only yesterday we were all saying that this miracle could not be. Had not the military experts themselves assured us that the accuracy and volume of modern rifle, machine-gun, and shrapnel fire was such, that not the finest troops in the world could be brought to face the tempest in a frontal attack in the open?

And yet this very thing has happened—not merely once, to be written into the chronicles of a nation's sublime heroics, but everywhere and every day throughout that far-flung battle line on which Teuton is locked in the death-grip with Frank and Briton.

Marvelous, also, is the fact that this matchless courage is being displayed, not by the toughened veterans of a long campaign, not by professional soldiers, steeled and tempered by the discipline of barracks and camp, but by work-a-day laymen, called at a minute's notice from the peaceful routine of their daily lives, and told to rush "into the jaws of Hell"!

Consider them, as they advance through the zone of death, compact, unwavering, and with every emotion save that of fear shining in their eyes. They have come, not from the snug shelter of the camp, but from the endless misery of the trenches in which, when man was not lashing them with lead and iron, nature has whipped them with wind and sleet and pitiless rains. Sodden, unfed, cold, and weary, they face the multiplied savagery of modern artillery with a heroism that the veterans of Napoleon, Blücher, and Wellington can scarce have equaled in the days of the less murderous smooth-bore and muzzle-loading musket.

Man need not be brutal to be physically brave.

Never, since the time when men first marched into battle, have armies taken the field in which there was such a high average of education and refinement as in these contending hosts on the French and Belgian battle grounds. Among these four or more millions of men we doubt if a corporal's guard can be found that is not able to read and write. And the grade of culture extends from that of the state schools up to the highest erudition of the colleges and universities.

War may be brutal; but the deeds of the citizen-soldier in this unparalleled test of the twentieth century, have proved that there is not the remotest relation between brutality and bravery. Rather, we have learned that the mental, moral, and artistic uplift of the age we live in, so far from stripping the race of the sterner qualities of manhood, has stiffened immeasurably its pluck, tenacity, and courage.

German Colonies as Outposts of Science

IF the Allies should win decisively in the great war, what will become of the German colonies? Some of them have already been wrested from the Fatherland, and in the case of at least one—Kiaochau—the present possessors have announced that their capture will never be restored to its recent owners.

If the above question is interesting on account of its political and economic aspects, it is no less so from the point of view of pure science. In fact, we are inclined to think that German colonization has been more fruitful in a scientific sense than in any other. Neither as commercial enterprises nor as homes for the surplus population of the parent country have the German dependencies been conspicuously successful. According to the latest statistics, these possessions had an aggregate population of 14,890,000, of whom only 24,170 were of European race, and of these only about 18,500 were permanent settlers. In other words, a single small town in one of the great self-governing colonies of Great Britain—Canada, Australia, or South Africa—could muster a larger number of Europeans (and, in some cases, a larger number of Germans!) than the entire colonial empire of Germany. Germans do not emigrate to the German colonies (so called), but to the United States, Canada, and South America. The strategic value of most of these dependencies is negligible. Germany, like any other great power, needed fortified coaling stations and dockyards in various parts of the world for the use of her navy, but could derive no military advantage from vast tracts of tropical jungle or archipelagos of atolls in the South Pacific; in fact, as the event proved, these possessions were merely an embarrassment in warfare.

In the years 1909-1910 Prof. Hans Meyer and his collaborators published the two sumptuous volumes of a monumental geographical work called "Das Deutsche Kolonialreich." In America, except to those of us who had seen the material of which this work is a digest in process of accumulation in such journals as the *Mitteilungen aus den deutschen Schutzgebieten*, *Petermanns Mitteilungen*, and various other *Fachzeitschriften*, its contents were a revelation—not of the extent to which the German possessions had been exploited commercially and politically, but of the thorough-going way in which each of them had been studied and explored by German geographers, geologists, ethnologists, climatologists, zoologists, and botanists.

German colonization in Africa began just thirty years ago, about the time when the great journeys of exploration in that continent were beginning to give place to intensive research. Here was a new world for German science to conquer. Germany sent out her soldiers, her traders, and her missionaries, just as other colonizing countries had done, but she also sent to each of her colonies a strong corps of *savants*, whose work was, for the most part, done under official auspices. Just to cite one phase of this work, each colony was soon dotted over with meteorological stations, the observations at which were taken by petty officials, planters, missionaries, and others, and ultimately published in great detail at Berlin, so that at the present day we possess more complete climatic statistics for German East Africa, German Southwest Africa, Kamerun, and Togo, than for any country in the Balkan peninsula except Roumania.

In short, the acquisition of a virgin country by Germany means the prompt accumulation of an immense fund of scientific knowledge concerning that country—collected with conscientious thoroughness, digested by experts, and presented to the world in a form that is a delight to the eye as well as to the understanding. The work of Meyer, already mentioned, with its profusion of statistical charts, photographs, aquarelles, tables, and descriptive text, is typical.

The scientific tasks undertaken by the Germans in their colonies are, of course, perennial. How well will they be carried onward by any possible successors? In all British countries it is notorious that scientific research receives but lukewarm encouragement from the government unless it can promise immediate material results. Much of the scientific work done in the German colonies would certainly be viewed askance by British administrators, though private enterprise would doubtless in some measure make amends for the lack of official support. The French government is more inclined than the British to give its moral support to pure science, but infinitely less inclined than Germany to devote public funds to the same object. France has done little for scientific investigations in French Congo compared with what Germany has done in Kamerun. Belgium need not be considered, as she has her hands full with the Congo, while Russia would not know what to do with an African colony.

Strong Magnetic Field for Solar Research.—MM. Deslandres and Perot continue, in the *Comptes Rendus*, an account of their experiments on the production of intense magnetic fields. This work has an important bearing on researches on solar magnetic fields. A very interesting part is that the judicious use of intense electric currents is more effective in constructing powerful electro-magnets than is the saturation of large masses of iron. Instead, therefore, of following along the lines of Weiss, whose truly ponderous apparatus weighs about 100 tons, they are constructing comparatively light and small electro-magnets. They have been able to test their new method of water cooling the magnetizing coils, and a field of 50,000 gausses has been obtained without the use of iron; this estimate being based on the effect of the field on one of the zinc lines. They use thin silver tape instead of wire in their coils, and the cooling stream of water flows across instead of along the tape. Using iron, the authors hope to produce a field of 150,000 gausses but their work has been temporarily, and perhaps permanently, interrupted by the war.

Engineering

The United States Naval Estimates.—The naval estimates for the fiscal year beginning July 1st, 1915, call for an appropriation of about $144,000,000. This happens to be the exact amount which was authorized in the naval budget passed at the last session of Congress. The administration will probably call for the construction of two battleships, six torpedo-boat destroyers and eight submarines; which, again, is the same as the addition made to the fleet in the bill passed at the last session.

Is the Torpedo Net Doomed?—According to the *Navy* a test was recently made under the direction of Commander John K. Robinson, U. S. N., commanding the naval torpedo station at Newport, Rhode Island, which seems to prove that the torpedo net is no longer a secure defense against the torpedo. In the experiment a torpedo with a heavy charge of gun cotton was fired from the torpedo boat "Morris," while she was running at eighteen knots, at a steel net which was moored to protect the target. The torpedo went through the net, struck the target, and exploded.

Increase in Marine Turbine Construction.—Up to the present time the total horse-power of marine turbines of the Parsons type, completed and under construction in the works of the company and of its lessees, as well as in the works of the continental companies, etc., amounts to about 12,360,000 horse-power, an increase during the past year of about 1,760,000 horse-power. Of this total about 10,500,000 horse-power is employed for the propulsion of warships, and over 1,850,000 horse-power is in vessels of the mercantile marine and in yachts.

Rubber Roads.—Considerable interest has prevailed in England for some time over the suggestion of using rubber for street pavements. Trial sections of such pavement were laid in the Old Kent Road, in London, some time ago, as this street carries some of the heaviest traffic of the city; and recently a specimen of this pavement was exhibited. The wood block pavement adjoining had worn down from an eighth to a quarter of an inch, but in the same time the rubber-capped wood blocks appeared as good as new; and it would appear from these tests that rubber pavements would be so durable as to make them an economic investment.

New Alpine Railway.—The longest Alpine railway in existence will run from Brieg, near the Italian border, to Disentis and will thus connect the former with the Federal Swiss lines. Beginning at the end of the Simplon tunnel, at 2,200 feet above sea level, this remarkable road passes directly over the Saint Gothard tunnel as a surface road at 4,700 feet above sea level and rises at one point to 7,100 feet. With a branch of an existing road, the new line will connect Brieg with Saint Moritz, between which points daily runs will be made each way and afford tourists a route of surpassing beauty through the hitherto remote and little known region of the upper Rhone and past the headwaters of the upper Rhine.

Navy Yard Bid the Lowest.—The Government navy yard at Mare Island, California, made an unofficial estimate of the cost of constructing one or more of the new 1,110-ton destroyers for the United States Navy. When the bids for these vessels were opened, it was found that the Mare Island bid was about $200,000 less for each destroyer than the bids submitted by private shipbuilding firms; and, as a consequence, Secretary Daniels has intimated that part of this work would be given to the yard on the basis of its figures. The Mare Island estimate was, for a single destroyer, from $626,670.00 to $674,917.00, according to the type of machinery and boilers installed. For building two destroyers, the estimate was from $12,500.00 to $17,000.00 less than for one. The new class will carry four additional torpedo tubes as compared with the previous class and two anti-balloon guns, and the speed is to be 29½ knots.

The Lights of London.—The dimming of the lights of London, which has been deemed necessary by the authorities as a protection against aerial attacks, has brought forcibly to the attention of illuminating engineers the great waste of light that has been universal in the past; and this condition prevails not only in London, but in every other city in the world. It is pointed out that in the case of shop windows there has been little endeavor to concentrate the light on the wares displayed, with the results that much light is wasted, and the excess is injurious to passers-by. Under these conditions the expenditure for light largely fails to secure the best returns, for the wares are not lighted to the best effect, and if the misdirected light is unpleasant to the passer-by he will not stop to observe. The same conditions prevail to some extent in the case of the powerful arc, flame and high pressure gas lights used for illuminating the streets; for it is felt that the illumination from these could be controlled and directed so as to secure a better distribution of lighting, and at the same time be more agreeable to the eye. Heretofore illuminating engineers have worked almost exclusively in the interest of the lighting companies, but the consumer will soon find it to his advantage to consult this comparatively new profession.

Electricity

Mercury-vapor Wireless Apparatus.—Peter Cooper Hewitt, well known for his invention of the mercury-vapor lamp and rectifier, has been working for the past few years to discover a means of employing the rectifying properties of the mercury-vapor tube for the receiving and transmitting of radio-telegraph and telephone signals. He now reports that he has succeeded, but is not ready as yet to give out detailed information on the subject.

Selenium for Measuring X-rays.—Selenium can be used to measure the strength of X-ray tubes. The rays are directed upon a selenium cell, according to a recently patented process, and the cell is placed in one branch of a Wheatstone bridge. Measuring the resistance of the cell when the rays fall upon it, this resistance is found to drop by an amount which, as in the case of light rays, depends on the strength of the X-ray tube. The present system includes some special methods of connecting up the selenium cell with the bridge and galvanometer so as to secure the best conditions for practical use.

Electric Benzine Process.—It is reported from Sweden that a Stockholm engineer, M. Vidstrand, has lately succeeded in perfecting an electric process by which he extracts benzine from coal. The method is not as yet made public and the details will be awaited with interest. It is claimed that the cost of production on the electric method will be considerably less than for the customary benzine processes. The resulting product answers all the requirements for a good fuel for automobile or other motors. The inventor has applied for patents in 18 different countries, it is said, and is making efforts to operate the system on an industrial scale. Where electric current can be had at a low rate, for instance, from hydraulic plants, such a method can be used to advantage.

Finding Pipes by Electrical Method.—Piping of various kinds such as gas, water, steam-heating, vacuum cleaning or compressed air, is often concealed within walls, generally under plaster, and when it comes to making repairs or replacing such pipes, their exact position cannot always be found without doing considerable damage to the wall. A recently-patented electric method for locating the pipes is simply a special application of the well-known induction balance principle. A convenient apparatus is made up consisting of two sets of coils placed on ends of a magnet bar. One set of coils receives alternating or vibratory current from a suitable source, and the other coils are connected to a telephone. The balance is first established so that no sound is heard in the telephone. When the device comes near the metal piping, this disturbs the balance and a sound is heard. It is thus an easy matter to find the exact position of the pipes and to reach them with less damage to the wall.

Hour-glass Electric Switch.—A European patent provides a convenient method of putting on an electric circuit for an exactly determined length of time. By the use of the hour-glass principle the device can be made with scarcely any mechanism. The action depends on the use of a pivot arm which can swing from one side to the other in order to control a contact. Supposing an hour-glass to be elongated and to take the shape of a glass bulb at top and bottom, connected by a tube; by pivoting the tube at the middle, the system can be made to swing about. With the top ball full of sand, its weight makes it incline to the right, limited by a stop, and the lower empty ball lies to the left. Allowing the sand to flow from the top into the bottom bulb, when enough enters the lower ball its weight causes it to drop and move to the center line. Without going into details, it will be seen that this movement can work electric contacts, and the hour-glass principle controls the time in which the contact is left on. Current can thus be put into any circuit for the standard length of time for which the hour-glass is adjusted.

Rotary Lamp Synchronizer.—A new rotary lamp synchronizer for use on switchboards of central stations to indicate whether alternators are running in step, combines the best feature of the motor type of indicator, but uses lamps which are lighted up in succession, so that it really has no moving parts. A set of 12 incandescent lamps is mounted in a circle in the box with a glass front, the lamps being connected to the secondary windings of a special 3-phase transformer whose primary is suitably wound to suit the voltage and frequency of the circuit. Secondary windings are arranged to give six equal voltages having equally spaced phase angles, a pair of lamps being connected across each voltage, the voltage of the incoming machine being connected to synchronize with one of the six secondary voltages. Two lamps of a pair are mounted at opposite ends of a diameter on the circle, and as one machine gradually overtakes the other, the lamps light up in rotation, thus giving the appearance of a revolving band of light. The direction of movement with reference to an arrow head indicates whether the incoming machine is running "fast" or "slow," and the right moment of synchronism is shown by the full brilliancy of one pair of lamps which far exceeds the ones before and after.

Science

Silk from Seaweed.—Dr. L. Sarasin has succeeded, according to *La Nature*, in making artificial silk from the "slime" of the seaweed which is thrown up in immense masses on the coasts of Normandy, Norway, Scotland, and Canada. An English company is said to be exploiting the process, for which a great future is predicted.

Sir Ernest Shackleton and the transantarctic section of his expedition sailed from Buenos Aires on the "Endurance" October 27th for South Georgia, from which point, as soon as a favorable opening is found in the ice-pack, the party will proceed southward. It is now intended to winter the "Endurance" in the Antarctic, instead of sending her back to Buenos Aires, as was originally planned.

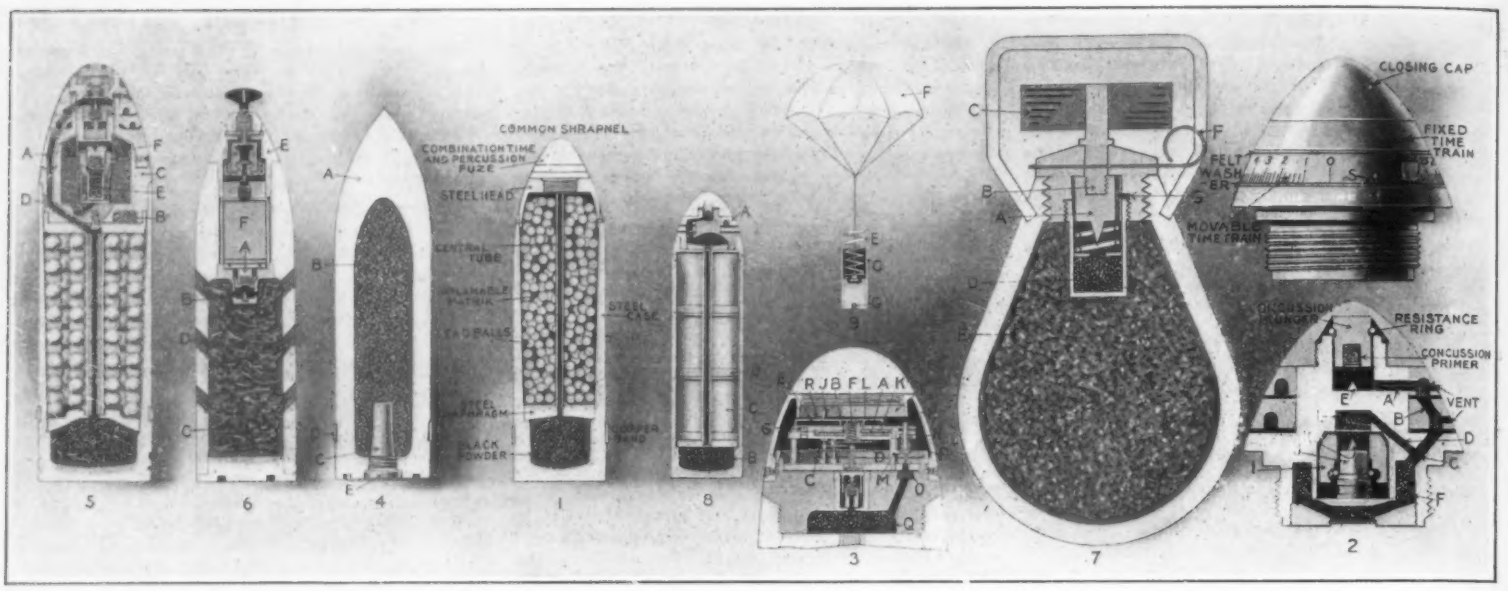
Microbes that Feed on Rubber.—Commercial rubber which is kept in perfectly dry air is not capable of furnishing nutriment to any form of microbe, according to a note in the *Bulletin* of the Pasteur Institute (Paris), but in the presence of sufficient moisture it may be attacked by certain bacteria or molds which feed on albuminoids, resins, and sugars. Some microbes form red, yellow, brown, or black spots on rubber without sensibly altering its properties. But there are two species of Actinomyces (*Act. elastica* and *Act. fuscus*) which are able to assimilate the hydrocarbon of rubber, and which may therefore so modify its properties as to destroy its value.

Memorial Tablets for Two Antarctic Explorers.—Two large bronze tablets, bearing appropriate bas-relief scenes and inscriptions, have been placed in the lower hall of the American Geographical Society, New York, one in honor of Lieut. Charles Wilkes and the other of Capt. Nathaniel B. Palmer. The inscriptions set forth the Antarctic discoveries of these two American sailors, and call attention to the fact that each discoverer is deservedly eponymous of the region whose existence he made known to the world. This is a timely reminder of the fact that the name "Wilkes Land" was spread over the whole coast of East Antarctica some generations before Sir D. Mawson applied it to a very minor portion of that coast.

The Problem of Protecting Against Earthquakes in Italy is discussed in a recent memoir by Prof. G. Agamennone, who points out that disasters from this cause are mainly due to faulty construction and bad location of buildings. It appears that after the greater earthquakes of recent times the authorities have formulated rules to ensure proper reconstruction, but these have been disregarded on account of the expense entailed and because the danger of another earthquake seemed remote. The author thinks the Italian government should establish a special ministry to control and systematize the work of mitigating the results of earthquakes, volcanic eruptions, flood, and other analogous disasters, and should provide state insurance against the losses due to these agencies.

The Value of Carbonic Acid Gas as a Plant Nutrient has been the subject of considerable recent literature, including an interesting paper by H. Fischer, describing experiments in Germany. The author found that the development of both foliage and flowers was stimulated by an excess of carbonic acid in the air, while the yield of tomatoes was doubled and that of cucumbers increased 12.5 per cent by carbonic acid treatment. It has generally been held that 0.03 per cent of carbon dioxide in the air is sufficient for plant growth, but Mr. Fischer thinks that more than this can be utilized, provided there is ample light, and that experiments in this direction might give valuable results. On the other hand, Mr. I. F. Kidd, an English investigator, finds that an excess of carbon dioxide in the atmosphere retards or inhibits the germination of seeds, but without injuring them. He suggests that the production of carbon dioxide in nature by the decay of vegetable matter may play a part analogous to that noted in his experiments.

Seismic Activity Near Charleston, S. C.—Few people realize that earthquakes still frequently occur in the epicentral region of the historic Charleston earthquake of August 31st, 1886, yet such is the case. In the *Bulletin* of the Seismological Society of America Mr. Stephen Taber states that during the past fifteen years these shocks have occurred at the average of one in every two months. Eight were recorded in 1912, and that of June 12th, 1912, was more severe than any felt in the district since 1886-1887. There has, however, been a gradual though irregular decrease in the frequency of shocks since 1886. The author believes most of these earthquakes to be due to adjustments taking place along a fault in the crystalline rocks underlying the Coastal Plain formations. Any factor increasing the relative pressure on the northwest side of the assumed fault, or decreasing it on the southeast side, tends to bring about a readjustment of the strata, with accompanying earthquake shocks, the most important of these factors being rainfall, height of the water-table, and barometric pressure. The shocks are most common in September and least common in April.



Typical projectiles of field artillery and aircraft, shown in section.

Field Gun and Aerial Projectiles

Construction of Shrapnel, Smoke, and Searchlight Shells and Bombs for the Use of Aircraft

FROM the earliest days of artillery it has been found necessary to have one type of projectiles for the destruction of men and animals and another type for the attack of inanimate objects. In the first case only a small amount of energy is required to disable an individual, and the energy of an artillery projectile must be divided many times to make it efficient. In the latter case the entire energy concentrated at one point is usually none too great. At the present time the common shrapnel which is separated into many smaller projectiles by explosion in the air, is the simplest for the attack upon animate targets and the high explosive shell which remains intact until impact is the typical projectile for the attack upon material objects. The fields of the two overlap to a small extent only and complications have been added by the necessity of having projectiles that are efficient against aircraft.

The construction of the common shrapnel, except that of the time fuse, is shown in Fig. 1. When the time fuse has burned the length of time for which set at the time of loading, a small magazine of powder in the fuse is ignited and the flame from this shoots down the central tube and explodes the black powder bursting charge in the base of the shrapnel. The case is made of a high grade of steel and does not break up at the time of explosion, but the entire contents and head are blown out to the front with increased velocity. The effect resembles suspending a huge shotgun in the air about one hundred yards in front of the enemy and firing it in that position. Each ball is intended to have sufficient energy to inflict a disabling wound, and effort is made to regulate the burst so that it will be in air and at a sufficient distance in front of the target to have an average distribution of balls of about one to the square yard of surface. In case of failure to burst in air the fuse is so arranged that explosion will take place on impact, but the small bursting charge causes little damage.

The light field guns of the various armies are of approximately 3-inch diameter of bore and fire projectiles weighing about 15 pounds. A shrapnel of this weight contains about 250 lead balls each ½ inch in diameter, and upon explosion drives them to the front with a velocity of about 300 feet per second, which must be added to the velocity with which the projectile was moving at the time of explosion. This increased velocity is of importance at extreme ranges, at which the projectile velocity may be as low as six or eight hundred feet per second. The matrix which is ignited upon explosion prevents deformation of the balls when fired from the gun, increases the visibility of burst and has considerable incendiary effect upon inflammable objects.

Firing a searchlight shell to disclose the movements of the enemy.

Fig. 2 shows a typical fuse used in the common shrapnel. As the projectile is driven down the bore the inertia of the concussion plunger causes it to slip through the resistance ring and strike the pin *E*, which explodes the concussion primer. The flame from the primer passes through *A* and ignites the fixed time train. To increase the length of the time train it is usually made in two parts, as shown, one of which is contained in a movable ring by turning which the time of burning is regulated. In the typical fuse the annular fixed train burns from the point of ignition hole *A*, until hole *B* in the movable train is reached. The movable train is then ignited through *B* and burns back to fixed hole *C*, communicating with magazine *F*. The greater the angular distance between hole *B* and hole *A* the longer the fuse will burn before explosion. By setting the movable ring so that *B* is opposite *A*, flame is at once permitted to pass through *B* and *C*, and the projectile is exploded within a few feet of the muzzle. The annular rings of time train composition do not form complete circles, and during transportation the blank space in the fixed circle is over hole *B*, so that in case of accidental ignition of the primer the flame cannot pass from the fixed to the movable time train.

A simple percussion or impact fuse is ordinarily

combined with the time fuse. In the typical fuse sleeve *I* slips over *J* at the time of firing, exposing pin *K*. Upon striking, *I* and *J* move forward and pin *K* strikes primer *L*, which ignites *F* by way of *D* and *C* and explodes the shrapnel. For percussion firing the fuse is left set as for transportation.

Time fuses of the type described have been highly developed and have excellent uniformity of burning, but, as one authority states, the method of measuring time by burning a train of powder is about as archaic in principle as King Alfred's candle clock. Clockwork fuses naturally suggest themselves as a solution, but the mechanical difficulties are great, owing to the forces exerted in overcoming the inertia of the parts when fired from the gun. The accelerating force on a part weighing 100 grains may be as great as 200 pounds, and deformation of a delicate part will result unless provision is made to support the same during the period of acceleration.

A typical fuse of the clockwork type is shown in Fig. 3. *A* is the main spring under tension, *B* the main spindle, which is hollow, *C* the escapement, and *D* a train of gears. All of these parts are similar to those of an ordinary clock. *E* is a lever which must rotate with spindle *B*, but which can move forward under the force of spring *F*. *G* is a pawl which locks the clockwork and also lever *E* in the position shown. *H* is a cap which can be rotated to set the fuse at the desired time of burning. The action is as follows: The inertia of pawl *G* causes it to move to the rear with respect to the other parts at the time of firing. This releases the clockwork and also permits spring *F* to push arm *E* against annular projection *I* of cap *H*. *E* rotates with spindle *B* for the time set, at the end of which it moves forward into notch *J*. This releases lever *K* from the restraint of annular projection *L* on *E*. *K* swings outward under the action of centrifugal force, rotating spindle *M*, thus releasing firing pin *N*, which is driven into primer *O* by spring *P*.. The primer ignites powder *Q*, the flame from which passes down the central tube and explodes the base charge of the shrapnel. The percussion elements are similar in principle to those of the combination fuse previously described. When percussion firing is desired, cap *H* is so set that on firing *E* moves directly forward into notch *R*, locking the clockwork.

High explosive shell, as shown in cross section in Fig. 4, are used with light field guns for the attack of men behind the shields of field guns, small field works and such other objects as can be appreciably injured with a small charge of explosive. The larger calibers of mobile artillery intended for the destruction of permanent fortifications or strong field works use these shells almost exclusively. Few commercial explosives are suitable for shell fillers on account of being unable to withstand the shock of discharge, deteriorating in long storage, being hygroscopic, exuding nitroglycerine, reacting on the walls of projectiles, etc. Picric acid or its salts either alone or mixed with substances intended to make them less sensitive or to improve the chemical reaction on explosion are most commonly used. To this class belong English lyddite, Japanese shimose, and French melinite. The principal objection to picric acid is its tendency to form sensitive salts when in contact with metals, and care is therefore taken to keep it from the walls of the shells by protective coatings of asphaltum paints, *papier maché* cartons, etc. Trinitrotoluol, derived from certain by-products of the gas works, although less powerful than picric acid, is coming into common use, as it is an almost ideal explosive from a military standpoint. It is manufactured extensively in Germany and probably is being used largely by that country in the present war.

Shells are as a rule fused to burst on impact only. The firing pin of the detonating fuse is armed essentially as described, for the percussion firing pin of the combination fuse. Upon impact the firing pin strikes a primer which detonates a small quantity of fulminate of mercury or other detonant, contained in the forward end of the fuse. This in turn detonates the high explosive bursting charge. In Fig. 4 *A* is the shell, *B* the high explosive, *C* the detonating fuse, *D* the copper rotating band, and *E* a copper base cover.

The necessity of carrying both shell and shrapnel and the impossibility of predicting the proper proportion has led to attempts to develop a compromise projectile which would perform the functions of both. This has resulted in the high explosive shrapnel, which has been quite generally adopted, and a type of which is shown in Fig. 5. The construction of the rear portion of this projectile is the same as that of the common shrapnel except that the matrix surrounding the balls is a substance, such as trinitrotoluol, which will merely burn when ignited by black powder, but which will act as a high explosive if a detonating fuse is exploded in contact with it. The head is larger than that of the common shrapnel and contains a small charge of high explosive, which in effect makes a small shell out of the head. The central tube is replaced for a portion of its length by the passage *A* in the wall of the head. The combination fuse is the same in principle as that shown in Fig. 2, except that the small magazine of black powder is replaced by a detonant. If it is desired to use the projectile as a shrapnel, the time fuse is set, and upon explosion of the base charge in air, the head and balls are driven out to the front. The explosive matrix merely burns and makes the point of burst more visible. The percussion elements of the combination fuse detonate the head on striking. The explosion of the head facilitates observation of fire, and under favorable conditions the fragments of the head are effective. When it is desired to secure the effect of a high explosive shell the fuse is not set. Upon impact the head detonates as explained above, and this detonation produces detonation of the matrix. The functions of certain other parts of the projectile shown are described in connection with projectiles for the attack of airships.

Aerial navigation led to the development of guns and projectiles intended especially for the attack of both heavier than air machines and balloons. Some of these were practicable, but for service with armies in the field, where transportation is rarely sufficient, it is impossible to provide ample armament for this purpose alone, and the practical solution has been to so modify the design of guns and projectiles in common use as to make them fairly efficient against aircraft without impairing their serviceability for other purposes.

Fig. 6 shows a projectile especially intended for the attack of balloons. At the instant of firing, primer *A* strikes pin *B*, exploding it, which ignites the large mass of incendiary material *C*. The smoke and flame from *C* pass to the air through vents *D D*, and enable the flight to be followed with the eye, which aids in adjusting the laying of subsequent shots. A sensitive percussion fuse *E* is provided, which upon impact with the slightest resisting substance, such as balloon fabric, will explode a bursting charge *F* which is sufficient to fragment the shell and seriously injure the parts near the explosion. In the case of a balloon the gas would probably be exploded by either the bursting charge or the burning tracer compound.

Fig. 5, in addition to illustrating the principles of the high explosive shrapnel, shows the modifications made in one type to render it more effective against aircraft. At *B* is a partial annular ring of inflammable material, resembling the time ring of a combination fuse. It is ignited by flame from the passage *A* at the time the base charge is exploded. As the head *C* continues its flight a trail of smoke is left by *B* and after a certain time *B* burns around to *D* and ignites the detonator *E*, which detonates the head. A quantity of smoke

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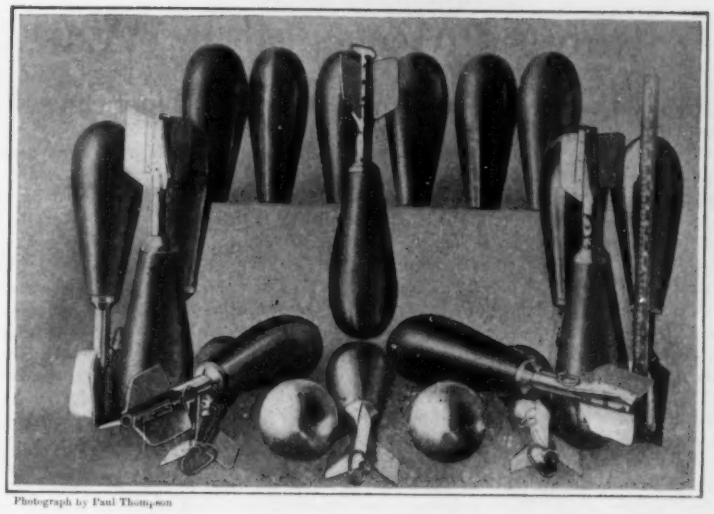
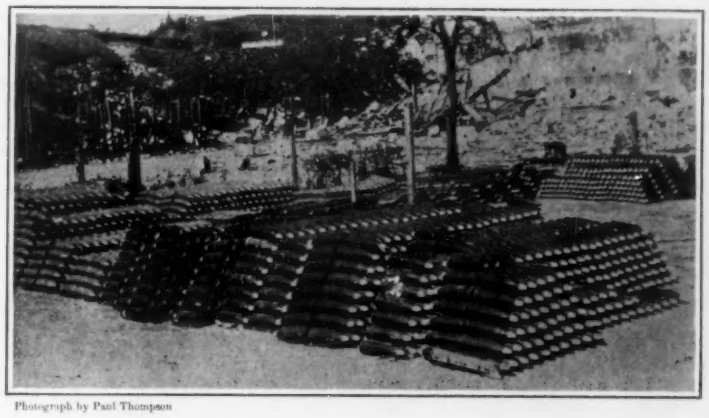


Photograph by Paul Thompson

Bombs designed to be dropped from aeroplanes and dirigibles.

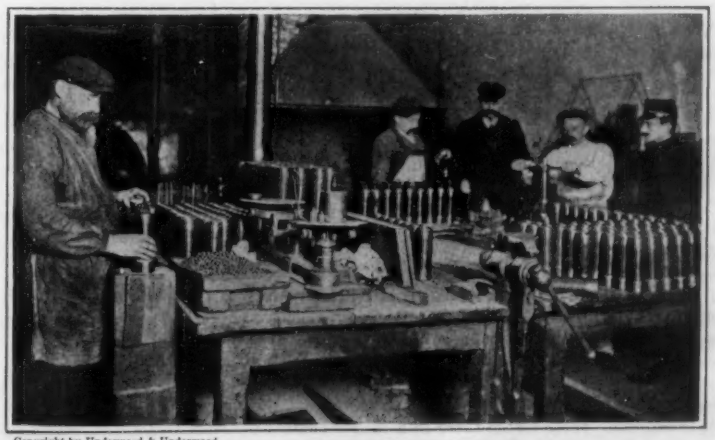


Photograph by Paul Thompson

Store of French ammunition found at the fortress of Longwy.

Photograph by Paul Thompson

Shells for big English guns on the quay at Dunkirk.



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Filling shrapnel shells with bullets.

Strategic Moves of the War

Letter from the Military Correspondent of the Scientific American, November 24th, 1914

The French Campaign.

THE war in Europe has now developed to a stage where the operations in Russia and in France are to some extent interdependent. German activity in Russia means comparative inactivity in France. During the past ten days Germany has been making one of the greatest strategic moves of history. Few of the details are given out in the official bulletins, but they may be surmised to some extent from the known facts.

In the west the Germans found themselves unable to make headway against the French and British. In the east the campaign to the Vistula had failed, and the Russians were advancing triumphantly to the borders of Germany. Germany faced disaster if she continued her policy of attempting a powerful effort on both borders. She adopted, then, the policy of holding the western line with the smallest force possible, while launching the troops thus released in a new invasion of Russia.

The relative strength of the opposing forces in France and Belgium have been estimated by one authority as 1,800,000 Germans against 2,300,000 Allies. Another authority estimates them as 1,600,000 against 2,700,000. Whatever may be the exact figures, there is no question but that the Germans are very much inferior to the Allies in numbers in this theater of operations.

As the Germans seem to have still further increased this numerical discrepancy in this recent shift of forces, the question arises as to how they can do it without inviting disaster. The decrease in numbers has necessarily caused a diminution in the energy of the German assaults, but for defensive fighting, which seems to be their present rôle in the western field, the Germans have a powerful auxiliary to supplement their lack of men.

The big development of this war has been the great improvement in artillery and in the supply service. Indeed, it is well named a machine-made war. Like any other machinery, the new highly developed types require fewer men, yet accomplish equal or even greater results.

Especially is this the case with the German machine gun, or automatic rifle, that has been quoted so often in the dispatches. It fires the same cartridge as the rifle, but has them mounted in long bands from which they are fed into the gun. Its fire for short periods at the rate of five shots a second gives it great value in stopping charges or in shooting up any bodies of the enemy that expose themselves.

The Germans have these guns posted so as to cover the ground over which attacks will probably be made. When the signal is received from the observing station that the enemy has reached the danger zone, the gun that covers this part of the front can then turn loose a storm of bullets that will wipe out any troops in its path. Ten men can in this way deliver as much fire with machine guns as can one hundred men with rifles.

Besides the advantage in machine guns, the Germans have so far had an additional advantage, in that their 6-inch siege guns could outrange most of the field guns of the French and British. But such equipment wears out rapidly in service; the bores get worn and the shooting is inaccurate; guns are captured; many are broken or destroyed. It is doubtful whether Germany can replace this great drain upon her equipment in spite of her great ordnance factories. The Allies, on the other hand, have not only their own gun works, which are working night and day, but they are also calling on most of the arms and ammunition factories of the world to aid in increasing their mechanical fighting equipment.

At present the Germans are counting on their superior equipment to enable them to hold back the western Allies while Germany and Austria prosecute their campaign against Russia. The French and British have had to fight for time to complete the equipment of their armies. France now has nearly caught up with Germany; Great Britain, though far behind, is steadily gaining. The situation in France seems to point to an early assumption of the aggressive by the French and British.

Meanwhile the whole week of fighting in the western field has consisted of bombardment and minor attacks. Fighting was reported at Dixmude, Bixschoote, and Ypres in Belgium, and in France at La Bassée, Arras, Lihons, Tracy le Val, Vailly, Rheims, Ornes, Les Eparges, Chauvoncourt, Cirey, and Ste. Marie. Yet in no place has the battle line been moved more than two miles.

At Chauvoncourt, on the west bank of the Meuse immediately across from St. Mihiel, the Germans have maintained their position in spite of desperate efforts by the French to dislodge them. The French gained the outskirts of the town, but were blown up by mines that the Germans left behind them in retreating, and were driven back again with great loss.

The most noticeable feature of the week in the western fighting is the sudden change by the Germans to a defensive rôle, and the apparent refusal of the Allies to accept the challenge.

The Russian Campaign.

In Poland events have moved fast. On November 16th the German flying wedge had reached Kutno, sixty miles from Thorn. Overcoming the Russian resistance here, the Germans pressed forward along the railroad and reached Lowicz three days later. A further advance brought them within forty miles of Warsaw, but also found their way barred by the army that the Russians had rushed to this field.

This move of the Germans shows bold and able strategy. Their invasion is not aimed at the Polish capital itself, but is directed at severing the main supply lines of the Russian armies in southwest Poland. Such a success would leave the Russians no choice but to make a rapid retreat toward the Vistula, with a weakening of control that might give the Germans a chance to get in some telling blows.

The Russian commander is also a strategist of demonstrated ability. The retreat of the Russians before the first onslaught of the Germans was undoubtedly planned to draw the latter farther from their railroads and thus to improve the Russian chances. However, the Russian retreat beyond the Bzura brings their forces to the south into such great danger, that it seems to have been forced by the suddenness of the advance of the Germans in unexpected strength.

The threatening move of the Germans against the right flank of the Russian army in Poland has been accompanied by a similar effort made by the Austrians against the Russian left flank. The abandonment of Galicia has enabled the Austrians to concentrate a strong army in the vicinity of Cracow. During the last week they have been making vigorous efforts to break through the Russian resistance along the railroad, twenty-five miles north of Cracow. On this flank the Russians have held firm. Their center is now able to pivot about this southern wing to fall back to a less exposed position. No news has been given out about the operations on this part of the line, but the safety of the Russian's center would seem to dictate its retreat to a line through Lodz and Piotrkow.

While endeavoring to stop the German invasion on the lower Vistula, the Russians are at the same time making an advance in Galicia that is threatening the Austrian right flank. By the capture of Neu Sandec on November 22nd the Russians gained the whole line of the Danojec River and deprived the Austrians of an important railroad leading into Hungary. The Russian occupation of Galicia is now complete except for the fortress of Przemysl and the district surrounding Cracow. The advance of Cossack divisions through the passes in the Carpathians may soon result in new raids into Hungary similar to those of September last.

In East Prussia the Germans have held the Russians to the line of the Angerapp River, thirty miles west of the border. Both sides in this fighting seem to have had their forces drawn upon heavily to reinforce the armies in Poland. Consequently, the fighting in this field is now a subordinate phase of the war. There seems to be a cessation of activities on both sides while waiting for the outcome of the decisive battle west of Warsaw.

The Turkish Situation.

The raiding force that Russia sent into Armenia on the outbreak of hostilities with Turkey proves to have consisted of about one corps of infantry and two divisions of cavalry. At Koprukeui, half way between the border and Erzerum, the Russians were checked by a superior force of Turks and were driven back to their own territory. The fighting since then has consisted of minor skirmishes along the border. Along the Black Sea coast the Turks have been pushing forward into Russian territory and now claim to have reached the Chorok River, fifteen miles from the border. All of this fighting amounts to little more than skirmishing as compared with the great battles that are taking place in Europe.

In Egypt the Turks have crossed the border and have invaded the Sinai Peninsula. By the capture of Katasa and Teatebe, twenty miles from the Suez Canal, they force Great Britain to make an active effort in protection of her line of communications with India. They now claim to have reached the Canal at El Cantara. The thoroughness of the censorship concerning news from Egypt and Suez suggests that the British consider their forces there in a rather critical position.

The results of the week of the war are, on the whole, favorable to the Allies. They have suffered no serious reverse and have gained a week in the training and the equipping of their armies that is a necessary precedent to more aggressive operations.

Responsibility of Science for Defectives

WITH the increasing density of population, and the corresponding difficulties in securing the necessaries of life, the struggle for existence between nations, communities and individuals is steadily becoming more intense, and this condition of affairs is attracting attention to the great numbers of defective and useless individuals among our population. How far the preservation of this class in the past is due to medical ethics and mis-directed public opinion, and the position of science in the future, is commented on by Prof. William Bateson in his address before the British Association at its meeting in Australia, as follows:

The powers of science to preserve the defective are now enormous. Every year these powers increase. This course of action must reach a limit. To the deliberate intervention of civilization for the preservation of inferior strains there must sooner or later come an end, and before long nations will realize the responsibility they have assumed in multiplying these "cankers of a calm world and a long peace." The definitely feeble-minded we may with propriety restrain, as we are beginning to do even in England, and we may safely prevent unions in which both parties are defective, for the evidence shows that as a rule such marriages, though often prolific, commonly produce no normal children at all. The union of such social vermin we should no more permit than we would allow parasites to breed on our own bodies. Further than that in restraint of marriage we ought not to go—at least, not yet. Something, too, may be done by a reform of medical ethics. Medical students are taught that it is their duty to prolong life at whatever cost in suffering. This may have been right when diagnosis was uncertain, and interference usually of small effect; but deliberately to interfere now for the preservation of an infant so gravely diseased that it can never be happy or come to any good is very like wanton cruelty. In private, few men defend such interference. Most who have seen these cases lingering on agree that the system is deplorable, but ask where can any line be drawn. The biologist would reply that in all ages such decisions have been made by civilized communities, with fair success, both in regard to crime and in the closely analogous case of lunacy. The real reason why these things are done is because the world collectively cherishes occult views of the nature of life, because the facts are realized by few, and because between the legal mind—to which society has become accustomed to defer—and the seeing eye there is such physiological antithesis that hardly can they be combined in the same body. So soon as scientific knowledge becomes common property, views more reasonable, and, I may add, more humane, are likely to prevail.

How Big is the 42-centimeter Shell?

WITHOUT question the most astonishing development of the present war is the great 42-centimeter gun, which has enabled the German army to smash its way through fortifications hitherto believed to be impregnable. But just how big is the missile that has rendered fixed fortifications obsolete? The question has been with us ever since we heard of the fall of Liège and Namur. Of course it is easy enough to figure that 42 centimeters is equivalent to about 16½ inches; but this is merely one dimension, and, after all, mere figures are apt to be quite meaningless.

In order to give our readers some conception of the enormous size of the shell, we have prepared, as a supplement to the present issue, a life-size drawing of it. We believe that even the man who has taken the trouble to measure off 16½ inches with a tape-line, in order that he might form a mental image of the giant missile, will be awed at the mammoth proportions of the shell when he views its full-sized reproduction.

Motor Transportation in the War.—The motor vehicles at the front are of all sorts and sizes, and, although their services have been invaluable, the great variety of sizes and makes has developed disadvantages. In a transport line the slowest car sets the pace, and this has proved a cause of delay. On the other hand, the smooth level roads often met with on the Continent, tempt the drivers of the faster machines to let them out, with the result that the heavily loaded cars are soon shaken to pieces.

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

A Parasite Sunflower

To the Editor of the SCIENTIFIC AMERICAN:

In the garden of one of the residents of this city there has grown during the past season a natural curiosity such as would not be believed possible by many, except upon the evidence of their own eyes. This is a grape vine, one branch of which is a sunflower. The sunflower leaves the main stem of the vine only about six inches from the ground, and a short distance up divides into two branches. Each of these branches bore a fully matured flower of the ordinary size and appearance.

To the casual observer, it appears that this strange freak has been brought about by the transformation of the grape vine into a sunflower, but such is not the case. A careful inspection serves to disclose the fact that at the point where the sunflower originates, there was a decayed place in the vine, into which, evidently, a stray sunflower seed found its way. As it developed, the sunflower stem filled this cavity, giving it the appearance of a genuine branch of the vine. The sunflower appears to have thrived in its strange habitat about as well as in its natural environment, and the grape vine was not injured by the parasite.

Mount Carmel, Ill. D. E. KEEN.

The Problem of Our Merchant Marine

To the Editor of the SCIENTIFIC AMERICAN:

The three articles appearing in the issues of SCIENTIFIC AMERICAN of recent dates, headed "Our Merchant Marine," are interesting from an historical standpoint, but rather pessimistic as to the beneficial results that may accrue to the United States and its citizens generally from the passage of the free ship bill recently enacted into law.

Those who have not pinned their faith on subsidy alone as a means of revitalizing our merchant shipping in the deep-sea trade are not particularly moved by the fears of those who have always advocated subsidy only as a means whereby we would again take our old-time place among the deep-sea shipping nations of the world.

As an instance of what seems a fallacious illustration: The author asks if our "nation could have saved itself in 1855-1860 by the purchase of 'free ships' from British yards," and goes on to ask "if any sane person believes that the mere purchase of a British steamship would make it possible to run that steamship profitably in competition with the Cunard Line, which was then receiving a subsidy of nearly $900,000 a year from the British government.

As to what might have happened if something had been done in 1855-1860 which was not done in behalf of shipping is merely guesswork. But we do know what has happened since 1891 and is still happening in the shipping transatlantic world.

The United States pays subsidies, called mail subventions, and has since 1891. The American Line with its four steamers referred to by the author has been drawing a subsidy from the United States since 1891 or thereabout; it amounts to approximately $700,000 annually. It was supposed that this act would greatly stimulate ship owning and operation in United States shipping, but the American Line never added a steamer built in the United States to the fleet with which it started out, so we might gather from such an experience that a mail subvention act if in effect in the United States in 1855-1860 would not have enabled an American steamship company to compete in foreign trade with the Cunard Line or British lines any more successfully than they are in these days.

Much has been made of the fact that there is no American shipping to carry our grain and cotton and other products to Europe; but our grain and cotton are shipped, nevertheless, and the freights go to enrich the owners of foreign-built ships, many of whom are Americans, who for reasons of profit preferred to operate under a foreign flag than under the flag of the United States, and continued so to do even after the passage of the Panama act, which gave the American owners of foreign-built craft, if not over five years old, the right to register them under the laws of Uncle Sam, and according to the author of the article, "Our Merchant Marine," not one of the foreign ships owned by Americans applied for American registration under this act.

The author exclaims against the West and South as being opposed to subsidy; he criticises the West and South for not expressing their willingness to be taxed on behalf of a special industry which gave no evidence of giving better service or lower ocean rates; and this criticism is still expressed while the Government of the United States is paying out heavy subsidies to various lines under the Mail Act of 1891 and for which the West and South contribute their share.

Our coastwise shipping is pointed out as a resulting justification of the prohibitive navigation laws which conserve the coastwise trade of the United States to ships built in our domestic yards; whether such a law, going to the extreme of absolutely shutting out foreign-built ships—not allowing them to be entered under our laws and engage in coastwise trade subject to a duty—is wise is a subject of grave doubt, and the more so as Great Britain imposes no such restrictions; foreign-built or foreign-owned ships may engage in her coastwise trade on the same terms as British-owned and built craft.

But our navigation laws have been in effect for a hundred years or more and our coastwise shipping came into being under them; such ships are of high cost as compared with the foreign built, and when it was proposed at the beginning of the European war to allow foreign-built tonnage to engage in our coastwise trade, a sturdy opposition was manifested and the proposition was dropped.

It is felt that a grave injustice would be done to our American shipowners and investors, who paid a protective price for their ships, to allow foreign-built steamers to engage coastwise; there would be but one end to such a competition; the more cheaply built foreign tonnage would eventually drive the higher priced American-built out of existence.

But while the question has been disposed of for the present, like Banquo's ghost, it will not down. The question exists as to why it costs more to build steamers in the United States than they can be built for abroad, while we produce steel and iron in greater quantities than any other two nations put together and ship our steel and iron all over the world in competition with and to almost every nation.

Labor cost is given as one of the reasons for the high cost of building ships in United States yards, but the fact that automobiles and locomotives and every kind of machinery which employs as highly skilled labor as is employed in shipbuilding, are exported, while we never export a ship or build one for foreign trade, does not seem conclusive as to the cost of labor being the reason altogether for our inability to compete with the foreign shipbuilder.

Examples of what the Mail Act of 1891 has accomplished are given: The Ward Line, the Red D Line, and the Oceanic Line are cited as a satisfactory showing for what this act has accomplished in the twenty-odd years of its existence; a rather pitiful showing it makes contrasted with what the free ship bill passed a couple of months ago brought about. Up to October 20th, seventy-four foreign-built steamers, of 266,373 gross tons, were registered under the American flag, and the end is not yet.

The freight money paid these vessels will come here and most of it will stay in this country; the American flag will be seen as it used to be, in every sea; trade may or may not follow the flag, but where the flag goes there is trade; there is evidence now that the United States is a deep-sea shipping nation; merchants of other countries will have a new respect for the United States. The ship of itself increases trade between the United States and other nations; its disbursements are of no inconsiderable amount, and the prestige of the United States is increased by the display of its ships and their disbursements in foreign ports; every nation welcomes shipping to its ports; ours as well as that of other nations.

Doubt is expressed as to the permanency of this American registration of foreign-built ships; fears are felt in some quarters that when the war is over, they will again return to foreign registration; the expense of operation under the American flag, even though the permission to engage foreign sailors is granted, and in support of that view the instance is cited that the wages of one of the U. S. Steel Corporation steamers were advanced from $282 per month to $420; this would make an added expense to the vessel of some $1,656 a year registered as an American vessel over what she would have to pay if she were operated under a foreign flag. Well, a steamer of 5,000 tons costs abroad less than $200,000, so the added expense would amount to less than 1 per cent. An item, to be sure, but it would seem that a difference of not more than this might be overcome by American owners.

There are other factors that figure in the future development of shipping under the American flag induced by this European war; it is questionable if foreign governments can continue to pay subsidies and bounties in the future to their shipping on the same liberal scale as now; manufacturing across the water is disrupted; material will cost more; the burden of taxation will be greatly increased in Europe; in many of the European countries bounties are paid to coal and iron companies; it is doubtful if they can or will be continued; if they cease, costs for these articles will increase, and the power of European competition with our producers lessened.

These are factors that should be taken into consideration in estimating the permanency of our free ship policy; as a policy it is a stimulant to our trade and our imagination; we really are, at last, a nation with a deep-sea merchant marine; it is true that the tonnage placed under our flag is practically freighting tonnage, but that is a most important element in our shipping and trade development. We need not stop there, however, nor will we. We want fast passenger and freight boats; we want mail carriers; we want to bring foreign nations, the South American nations, close to our doors through the medium of *our* ships; we want to be, and need to be, at the head of the shipping nations of the world; our trade justifies it, our needs demand it; and as all free-ship nations pay subsidy for the development of shipping on special lines and in special trades, there would seem to be no good reason why the United States should not do likewise; there is one thing certain, fast steamers in regular lines cannot operate successfully under the American flag when they have to compete with the subsidized lines of foreign countries; we have not reached that stage where private ownership of steamship lines operated under the American flag can compete with the government-aided lines of Europe; they do not have to; the Mail Subvention Act is still in effect; there is nothing to stop the expansion of shipping under our flag; liberal payments are provided for ships operating under this act; it is pointed out that it has worked successfully in the West Indian and Venezuelan trade; the American Line operates under it to Southampton, or did till the war started; why should it not be taken advantage of, to a far greater extent?

After the war is over there is expected to be a vast emigration movement to this country; what preparations are American shipping lines making to share in this traffic?

Much is made of the differential duty that applied to goods brought in in the early days of the Republic; we have the differential duty now, though not yet in force; but times and conditions change, and it is doubtful if the differential duty would aid to any great extent in upbuilding shipping under the American flag to-day. The great lines of freighting imported now are on the free list; ore, wool, hides, meats, lumber, fish, corn, and wheat pay no duty, and so there is no financial inducement to use an American steamer in preference to a foreign in such lines of freighting, leaving out of consideration the commercial treaties that cover the treatment to be accorded vessels of the United States and those of the countries with which the United States has treaties.

There are two great forces now in effect that should aid the enterprise of Americans in shipping—free ships and the Mail Subvention Act; shipping is one of the greatest factors affecting the commercial welfare of nations; the financial feature of it makes it one of the greatest of industries; it has been charged that no mention is made of the profits arising from it by the foreign companies engaged in shipping, but it can be stated that the financial columns of our papers give a summary of the earnings and dividends paid by the most important of the transatlantic lines, but make little, if any, mention of what our coastwise earn or pay; with the greater interest now taken in shipping and its development we may expect the growth of a wider knowledge of the shipping industry of the United States, and with the interest of the public awakened to the fact that in shipping there is a great field for investment; that we have now a great fleet of steamers operating under the American flag; that the Government is in position to aid shipping under the Mail Subvention Act, still in effect; it is to be hoped that some of the energy spent in seeking subsidies will be devoted to development of American shipping under the favoring conditions now ruling.

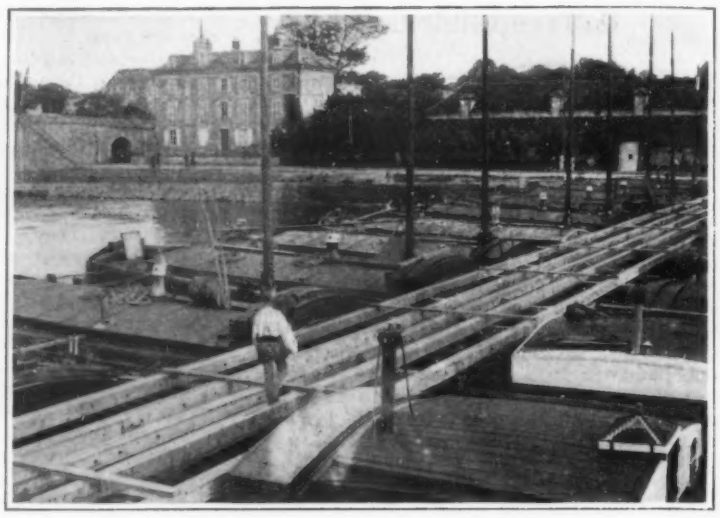
If the present Government aid is proven to be still insufficient to bring about the results in which the country generally is interested, to place the United States among the very first of shipping nations, then it can readily be determined what further steps need be taken to bring it about.

In the meantime, the conditions ruling give us the opportunity to secure a place in the shipping trade of the world that has not existed since the birth of the country. Will we have the courage to take advantage of it?

CHARLES DEEPSEE.

To Knight Aerial Fighters.—The well-known English writer, H. G. Wells, wants to have the aerial fighters of the British army knighted; and this is the way he puts it: "Every aviator who goes up to fight—I do not mean to reconnoiter, but to fight—will fight all the more gladly with two kindred alternatives in his mind: a knighthood or the prompt payment of a generous life-insurance policy to his people. Every man who goes up and destroys either an aeroplane or a Zeppelin in the air should, I hold, have a knighthood if he gets down alive; and I venture to say that we shall create thereby the most honorable and enviable order that this world has ever seen."

French ponton bridge thrown across the Marne at Lagny in three hours.



Building a large ponton bridge over the Marne.

Building Bridges Under Fire

One of the Most Difficult and Spectacular of Army Operations

By Martin Wells

MORE than once the success or failure of a campaign has depended upon the successful passage of a river, a barrier of flowing water to further advance. Held strongly by an enemy on the far bank, the offensive movement of a greatly superior force has been checked so thoroughly that a strategic victory has resulted for the lesser arms and the strength of an invader rendered impotent.

From these lessons of military history, definite procedure for pontoneers has been evolved. The various parts of material which go to make up a bridge train have been tested and re-tested. Every expedient has been resorted to, to make weight as little as is consistent with strength and adequate service, while an organization has been completed, in every army of the civilized world, with minute attention to detail, to make the ponton bridge service so efficient that no chance of an upsetting of plans could come about. Every detail has been looked into and provided for.

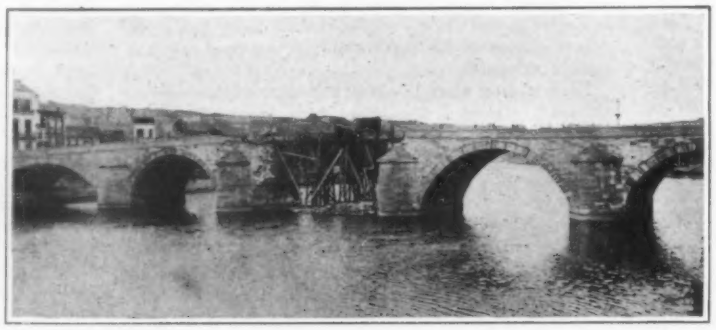
In these days of general staffs, it is safe to make the statement that the territory of each country which may become a possible theater of war is thoroughly mapped out and the maps filed away in the steel cases of some war college. Not only is the terrain plotted, but the physical resources of each country are accurately estimated, that an invading army may know where to lessen the amount of supplies of certain kinds to be forwarded by the line of communication service, by knowing what may be secured in the country itself.

From the maps and this data each possible campaign is forecast in minute detail. During the piping days of peace, the staff classes devote hours a day to working out these details, and when they are completed and approved, the plans are filed away, to be unearthed upon the approach of war or altered, to post to date.

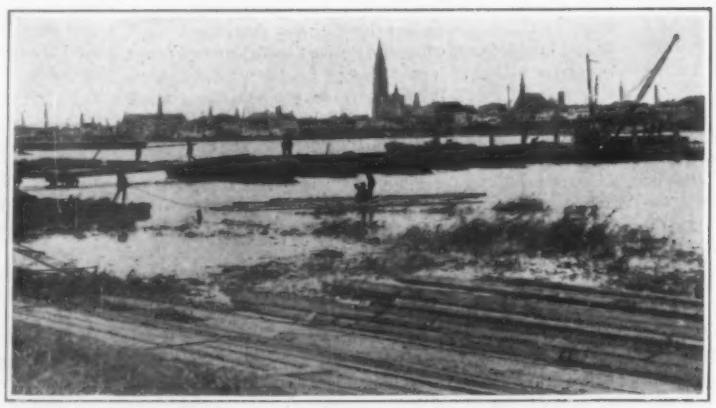
In these plans the bridge trains are considered. The maps show where the rivers are. The science of war predicts where a wise enemy will have destroyed his permanent bridges, and the plans of the general staff, ever seeking to make the line of communication and transport columns as light as possible, call for the dispatching of bridge trains to proper points at the proper time.

As used to-day, the ponton bridge is scarcely a century old, yet it has been used in warfare, in some lesser form, almost since there was war by forces with any pretense of organization. In the early days of Britain, the tousel-headed savages used, as a river-crossing expedient, the skins of animals, inflated, tied, and bound together, to form rough rafts, on which the wild soldiery effected a passage. And at exactly the same time, the legions of Rome used the same method, supplemented by the craft of commerce.

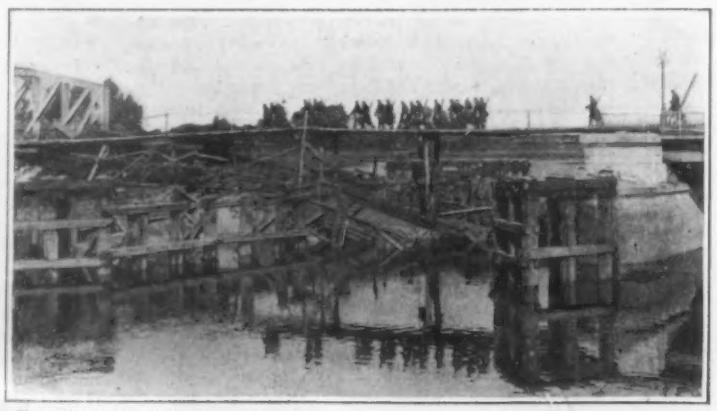
Most of the lessons which are applied to pontoneering to-day come directly from the American civil war. During those horrid days, when the soldiers of a divided nation clawed at one anothers' throats, the science of pontooneering was developed to its highest phase, and the use of bridge trains was so constant, that foreign observers gave particular attention to the way in which the problems were worked out in warfare, and the present almost universal system has resulted.



Bridge at Huy blown up by Belgians and repaired by Germans.



Belgians building a ponton bridge across the Scheldt at Antwerp.



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Bridge over the Scheldt destroyed by Germans and repaired by Belgians.

One of the greatest lessons of the service has carried the conviction that a ponton bridge may not be thrown across a river held by the enemy, in daylight, unless under cover of a fog. Time and again it was tried during the Civil War, and disaster always resulted. The attempt at Fredericksburg, by Burnside, to force the Rappahannock in the face of the Confederate fire, a mere handful of Barksdale's sharpshooters, was such a hopeless failure, that, pressing as the necessity for crossing was, the plan was abandoned until the fall of night.

In any case, losses must be sustained, so the lesser evil has been chosen. In modern times, when it is of paramount necessity that a river be crossed by daylight, in the face of an enemy, the pontons are used as bateaux, and detachments are ferried across at the safest points to clear the opposing troops away, while the friendly artillery endeavors to cover the ferriage. When the opposite bank is once held, in spite of the enemy's fire the erection of the bridge may usually proceed.

The situation depicted on the cover page represents a surprise attack upon a party of pontoniers from a masked battery, and not an attempt to put a bridge across a stream in the face of shrapnel fire.

There is little difference between the bridge trains of various powers, except in minor details. The broad principle is the same, and since the modern ponton bridge is mainly based upon the American method, it is better to discuss that merely.

Bridge trains are divided into two classes, the heavy and the light, sometimes called reserve and advance guard trains. The boats and material of the advance train are much lighter than those of the reserve, for the boats are a mere knockdown framework over which canvas is stretched to form the buoyant float. Mobility is the watchword of the advance guard trains, for they must be able to rush ahead with independent cavalry, sometimes three days' march in advance of the main body.

The very lightness of construction of these trains has its drawbacks, for the frail canvas covering has not the strength to stand the battering of an ice-choked river or the constant strain of a contin-

uous line of transportation. In addition, a canvas boat is much more easily put out of commission by a hostile shot than is one of the heavier wooden boats of the reserve train. There are four methods of constructing a ponton bridge: By successive pontons, by parts, by rafts, and by conversion. In the first case, each ponton is put in place from one or both banks, and the span of the roadway completed in turn. By parts, sections of the bridge are built along the bank, floated to position, and the smooth, unbroken roadway fitted in, with all the boats of the bridge an equal distance apart. By rafts, the ponton sections, consisting of five or six pontons, with roadway, are constructed at the bank, floated to position, and the end boats of each raft are lashed to the end boats of the adjoining rafts, with the roadway completed by false balks and roadway over the joint. The method by conversion is the hardest of all, for with it the pontoniers must be thoroughly experienced men and know their business. Even the carelessness of one man, in casting an anchor at the wrong place, may upset the entire scheme and nullify the operation. In conversion, the entire bridge is built along one bank, an end secured, and the entire bridge is then permitted to swing out on the current until, pivoting at the near bank, the bridge is swung into position across the river, when the abutment bays of the roadway are laid.

This method of pontoneering was employed by Napoleon when he made his way against the Austrians from the island of Lobau. A great French engineer conceived the plan and referred it to his Emperor, who adopted it on the spot as the means by which to make a sudden and unexpected crossing. Had the successive ponton system been employed, the enemy would have had ample notice, but as the time required was but sufficient for the bridge to swing into position, it lent itself to the unexpected, upon which the attack was founded.

The method of constructing by successive pontoons is the one usually employed when the stream is not too broad. Assuming that a force of an enemy holds an opposite bank and that it is necessary to dislodge him and cross, the method of procedure is about as follows:

Under the protection of rifle and artillery fire, the ponton wagons are brought as close to the bank as shelter permits, when the pontoneers, aided by details of infantry, lift the boats from their wagons and transport them by hand, at a run, to the edge of the water, then launch them.

Accompanying them, the infantry details which are to make the crossing in the attempt to dislodge the enemy, come up on the run and file into the boats, where the pontoneers already man the oars. The infantrymen take seats alternately, right and left, so as not to disturb the equilibrium of the boat, and as soon as it has its quota of men, the boat pushes off for the opposite bank, while the friendly forces redouble their efforts to keep down the enemy's fire. As under no conditions must the stability of the boat be upset, stringent orders are issued that no attempt at rendering assistance to a stricken comrade must be made, and that no shot is to be fired from the boat.

When the boat finally grounds on the opposite bank, the survivors spring out and rush the bank. Probably the entire bridge train has been employed in the ferriage, so a fair number of men can probably be landed on the far shore. These men take up the task of clearing out the enemy, while the pontons return at once to the other shore to begin the construction of the bridge.

A shallow trench has been dug in the bank and a sill laid, for the security of the abutment span. The first ponton is anchored in position, the length of the span away from the bank, and the balks or stringers are laid in the notches. Beginning from the shore, the waiting pontoniers rush forward with the flooring, the chess, as it is called, to be followed by the bearers of the side rails, which are securely fastened with rack-lashings. By the time the first span is laid, the second ponton is in position, and the work continues until the bridge is completed. Each ponton is securely anchored with an upstream anchor, while every other one, at least, is secured by a down-stream anchor, in addition. Spare pontons and rafts are anchored above the bridge, ready to be floated into position in case of accident, such as the striking of a destructive shell.

By the time the end of the bridge is nearing the opposite bank, the troops which are to cross are approaching the initial point, the entrance to the bridge, where engineer and staff officers keep careful watch to see that there is no crowding. The commanding officer of each column has been told almost the exact second when his command should enter the bridge, and he has his troops under way at the proper time, to prevent any massing of troops about the approach.

Infantry is required to break step in crossing, for the rhythmic beat of marching feet would soon set up such a swaying of the bridge that the anchors would be broken out and the bridge racked to pieces in a few moments. Cavalry and artillery dismount and lead the horses across. Troops and carriages are required to keep certain distances apart, to prevent the concentration of weight upon any part of the bridge, and men are stationed along the length of the bridge to see that there is no crowding.

In case of accident, when there is time or material, one or more boats are posted below the bridge to assist in the rescue of any who may be precipitated into the water, by the enemy's fire or otherwise.

The ponton trains are so small in comparison with the combatant forces of an army that they receive little attention from the general public. As a matter of fact, the service is about as spectacular and dangerous a one as exists, one that calls for cold nerve and judgment, and it is a service so important, that at times the fate of a nation may hang upon a perfect functioning.

In peace, the engineers are constantly drilling with their bridge trains, using every method and throwing their swaying structures across different waters, in the effort to perfect themselves against the time of need when their drilling may be necessary under the grueling fire of a determined enemy. It is a great service, and the engineers and pontoniers rather pride themselves upon their unobtrusiveness, yet glory in efficiency. Their motto, "*essayons*," "let us try," is an epitome of their spirit.

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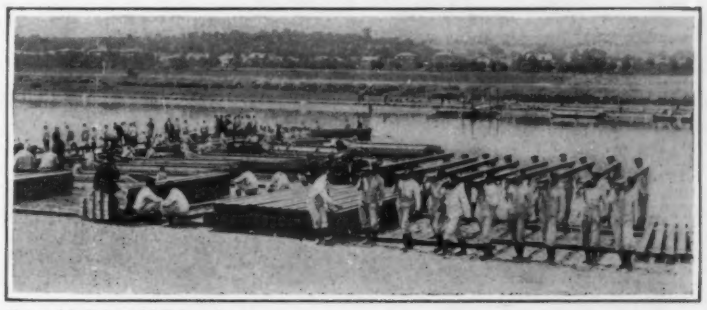
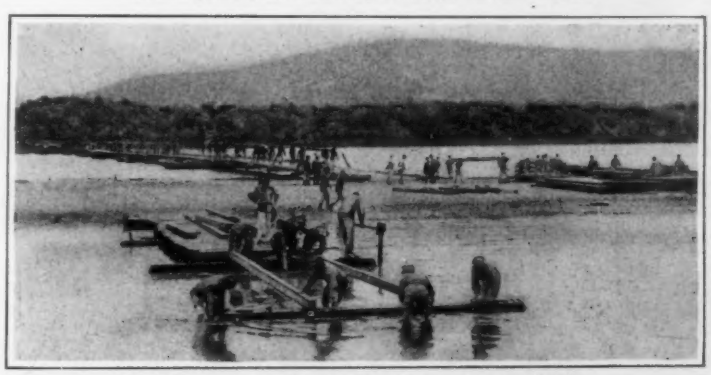
British pontoniers rowing a ponton into position.

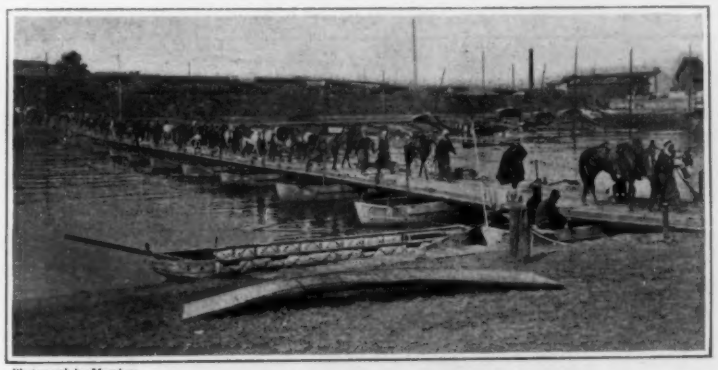


Photograph by Underwood & Underwood

German pontoniers throwing a bridge across a river.

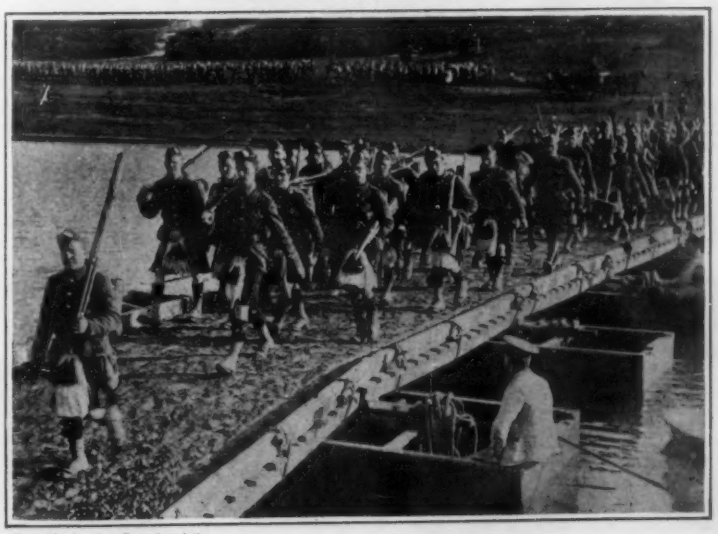


Austrian army engineers at work on a ponton bridge.



Photograph by Maurisse

Convoy of Spahis crossing a ponton bridge at Compiegne.



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Scottish troops crossing a bridge built by British engineers.

Making Mirrors by Electricity

A RAPID and admirable method for depositing suitable metals on the surface of glass so as to produce mirrors consists of decomposing the metal by means of a high potential electric current. It is thus described in the *Physikalischer Zeitschrift* by G. Rumelin.

A metal plate is placed in juxtaposition with the glass plate which is to receive the coating. The two plates are then placed flat on a table beneath the receiver of an air-pump suitable for producing a high degree of vacuum, such, for example, as the rotary pump of Gaede. A small quantity of an inert gas, such as hydrogen, is introduced into the vacuum and a high potential current is then turned on by means of the negative pole of a suitable source of electricity, this pole being attached to the metal plate. Thirty seconds duration of this cathodic flow is sufficient to obtain a properly silvered mirror. Besides silver the metals gold, copper, platinum, nickel, iron, palladium, and iridium may be employed.

A Novel Advertising Sign.—In patent No. 1,096,088 Gridley Adams of New Rochelle, N. Y., shows an advertising sign in the way of a concrete embodiment of the "parallax of motion," and in which the illusion of motion in an automobile representation is sought to be effective.

Djémal Pacha, Turkish Minister of Marine.

The Military Resources of Turkey, the Latest Country to Enter the Great World War

An Army of Proved Fighting Ability—A Navy Which Has Yet to Win Its Laurels

Enver Pacha, Turkish Minister of War.

THERE is probably no army regarding which it is more difficult to make any definite statement of strength than that of Turkey. The estimates of the total number of men, fully armed and equipped, that Turkey can put in the field vary all the way from over 1,200,000 to 500,000, the latter being the estimate of certain military men in the United States Army, whose opportunities for gathering information on this subject are unusually favorable.

In 1910 there was undertaken a revision of the whole military system, and at that time the term of service was 20 years from the age of 20 to the age of 40 for all Ottoman subjects. Formerly Christian subjects of the Ottoman Empire were exempt, but had to pay an exoneration tax; to-day, unless a change has recently been made, Christians are subject to service.

In 1910 the total war strength of the infantry was given as about 1,150,000 rifles, with other troops in proportion; but it is quite unlikely that such a force existed anywhere but on paper.

When the war broke out, the reorganization and re-equipping of the Ottoman army under the German general, Von der Goltz, was under way, but far from complete; and there is no doubt that the sudden declaration of war by the Balkan States found the Turks at a disadvantage of unpreparedness, comparable to that of the French when the German troops poured across the neutral lands of Belgium.

The crushing series of defeats of the Turks wrought havoc in their army. Some of the best regiments were all but annihilated, a vast amount of artillery and general equipment was captured or destroyed, and, worst of all, a serious blow was struck at the *morale* and prestige of the whole army.

In the interval since that war, the government, with German assistance, has been carrying on the reorganization. How far this has progressed, and just what is the effective strength, it is difficult to say. Judging from dispatches from Constantinople, there has been a large influx of Germans among the officers, especially in the higher commands, and it is believed that the artillery has been strengthened by the importation of field guns and howitzers from Germany.

Advices from Constantinople are confusing and contradictory; but it is known that all men between 18 and 45 have been called out. A levy in mass is, apparently, being tried; and there are races in Turkey, the Arabs of Arabia, for instance, who under favorable conditions, would be somewhat formidable.

How many men could be enrolled is dependent upon data which is rather vague. It depends not merely upon the total population, but upon the popularity of the war and the degree of control of the Stamboul government. That control is very little felt in Arabia and among the Kurds of Armenia.

It is not believed that the declaration of a holy war will have the far-reaching effects that have been popularly supposed. Its influence will probably be confined to such tribes as those above mentioned. It is not believed that it will lead to practical results among the huge Mohammedan populations that are subject to Great Britain and France.

The Turkish infantry is armed with the Mauser rifle (model 1887 and 1890), of which there are said to be over 1,000,000 issued and in store. There are, or recently were, over 500,000 Martini-Henry rifles in reserve.

The strength of the Turks in artillery is not known with any accuracy. Ten years ago there were 1,188 guns in the field batteries, 108 in the horse batteries, 240 in the mountain batteries, and 72 guns in the howitzer batteries. The field gun is of the Krupp pattern, the howitzer of the Schneider pattern, with some Krupps.

The Turk, when properly officered, is a redoubtable fighter; and we say this in spite of his overwhelming defeats in the Balkan war; for in that struggle he was taken unawares, and the leadership was poor. Under German guidance at headquarters and German control in the field, he will undoubtedly give a good account of himself in the present war, in which his chief handicap will be his numerical inferiority to his Russian enemy. For it is the opinion of the best informed military men in this country that if the Stamboul government places 500,000 well equipped regular troops in the field, that figure will represent its maximum effort.

Turkish field gun on the march.

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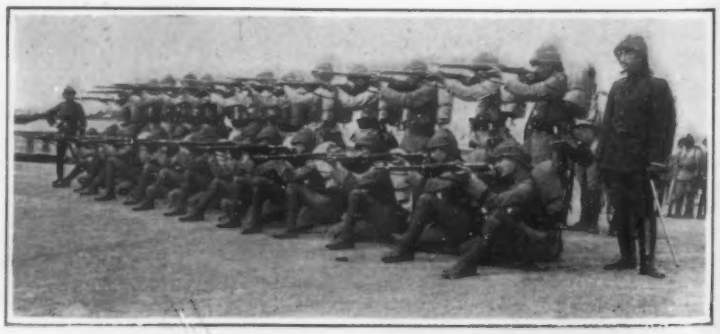
Turkish infantry in their new uniforms and cloth-covered helmets.

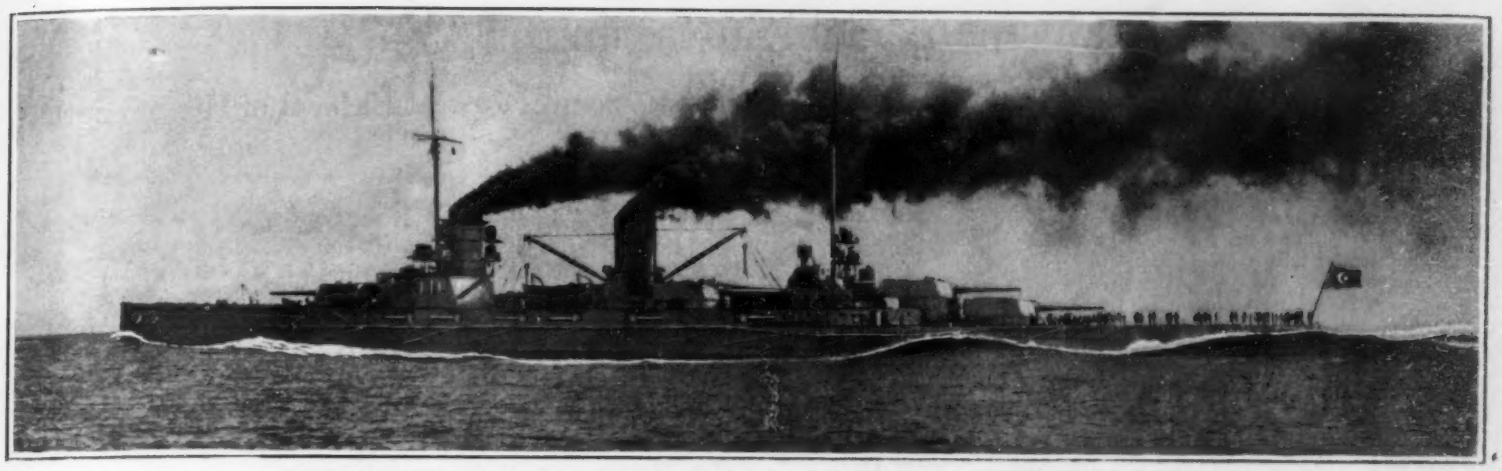
The Turkish Navy.

Until the year 1910, when Germany was engaged in the reorganization of the Turkish army, the Turkish navy was a negligible quantity, such ships as it possessed being in the main old, ill-manned and in poor repair. In 1910 the Turks acquired by purchase from Germany two of the older battleships of that power, the "Kurfurst Friedrich Wilhelm" and the "Weissenburg," of one of which we present an illustration. These ships were laid down respectively at Wilhelmshaven and Stettin in the year 1891. They are of 10,000 tons displacement and 17 knots speed. They are protected by a belt of 15¾ inches of the old compound armor, with 11¾ inches on the gun position. They are armed with four 11-inch, 40-caliber guns and two 11-inch, 35-caliber guns, carried in three barbettes, the guns themselves being protected with 5-inch gun shields. One pair of guns is mounted forward on the forecastle deck, one amidships on the main deck and one on the main deck aft of the mainmast. The torpedo defense battery consists of eight 4-inch guns mounted in a central battery protected with 3 inches of armor. The ships were built at a time when the necessity of lofty freeboard and high command for the guns was not fully recognized, the freeboard forward being about 19 feet and aft about 12 feet. In smooth water, and at not too great a bat-

A mountain battery in action.



Company at rifle drill.



Date, 1912. **Tonnage,** 23,000. **Speed,** 28 knots. **Belt,** 11-inch. **Guns:** Ten 11-inch, twelve 6-inch. **Torpedo tubes,** 4.

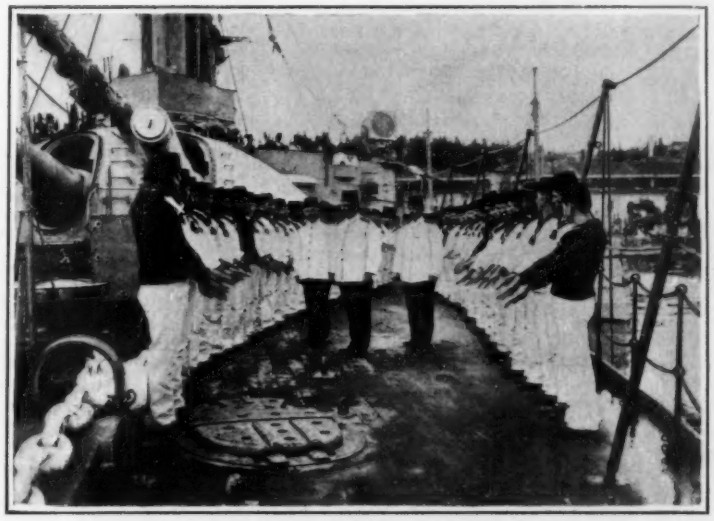
Former German battleship "Goeben," now flying the Turkish flag.

tle-range and with good gunnery, these two old battleships should be fairly effective, even to-day. In rough weather, and if opposed to modern ships with the latest types of gun, they would be hopelessly outclassed.

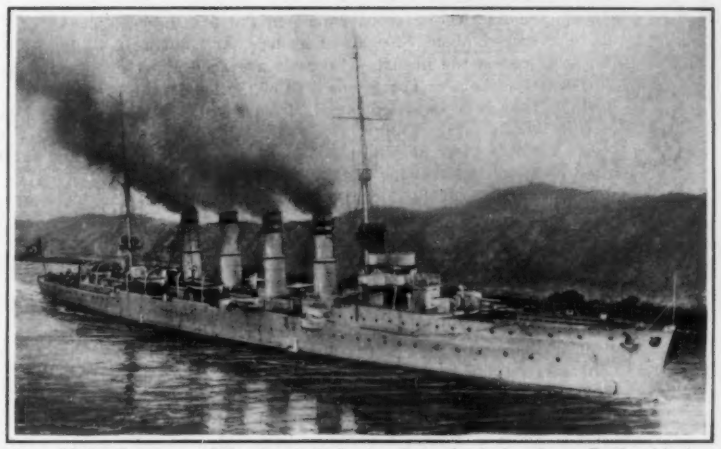
At the outbreak of the war, two of the most powerful battleships afloat were completing in British yards; one, the "Sultan Osman I," formerly the "Rio de Janeiro," commenced for Brazil, and the other, the "Sultan Mehmet Rechard V," built directly for the Turkish navy. The former mounts fourteen 12-inch guns and twenty 6-inch; the latter ten 13.5-inch and sixteen 6-inch. These two vessels were, of course, taken into the British navy on the declaration of war. The loss to Turkey was partially made good by the Germans, when the battle-cruiser "Moltke" and the scout-cruiser "Breslau" took refuge in the Dardanelles. It was reported that these two ships were sold to Turkey. Their German officers and crews remained aboard, apparently awaiting the developments which were shortly to come. When Turkey entered into the war these ships became immediately active as part of the Turkish fleet.

The "Moltke" alone, with her powerful battery of ten 11-inch, 50-caliber guns, and twelve 6-inch; her excellent protection of an 11-inch belt, and her high speed of 28 knots, is worth more to Turkey than the whole of the rest of her navy. The "Breslau," moreover, of 4,550 tons and 28 knots, protected with a 3½-inch belt and mounting twelve 4-inch guns, is worth more to Turkey in the work of commerce destroying than the two or three protected cruisers which she possessed when the war opened.

Next in fighting value to the four German-built ships above described are two protected cruisers, the "Hamidieh," built by Elswick in 1904, a ship of 21 knots speed and 3,800 tons displacement, mounting two 6-inch, 45-caliber guns and eight



Inspection on board the battleship "Hairredin Barbarosse."



Date, 1912. **Tonnage,** 4,550. **Speed,** 28 knots. **Belt,** 3½-inch. **Guns:** Twelve 4-inch. **Torpedo tubes,** 2.

Former German scout-cruiser "Breslau," now Turkish.

4.7-inch, 50-caliber guns, and the "Medjidieh," built in 1904 at Cramp's yard in this country, a ship of 22¼ knots and 3,330 tons displacement, mounting the same battery as the "Hamidieh." The "Hamidieh" distinguished herself during the recent Balkan war. These two cruisers, although they mount a much heavier battery than the "Breslau," are unable, like her, to cruise with the speedy "Moltke"; on the other hand, the Russian Black Sea fleet contains no cruisers that are comparable with them for effectiveness in a cruiser engagement.

From the ships already mentioned there is a big drop in value to the other units. Thus, the Turks have the "Messudiyeh," built in England as far back as 1874, and reconstructed at Genoa in 1902. This vessel is of 10,000 tons displacement and 14 or 15 knots speed. She mounts two 9.2-inch and twelve 6-inch, and has a belt of 12 inches of soft iron armor, easily penetrable. Another old ship is the "Miun-I-Zaffer," constructed in 1869, and rebuilt in 1907. She is of 2,400 tons displacement and 12 knots speed, and mounts a battery of four 6-inch guns. Her protection is 6 inches of old iron armor. To these must be added some eight or nine gunboats of from 200 to 775 tons and from 12 to 22 knots speed.

The Turks possess a fleet of eight modern destroyers of two classes, one of four boats of the "Samsoun" type, completed in 1910, of 305 tons displacement and 28 knots speed, mounting two torpedo tubes. The other class of four, named after the "Yadikiar-Milet" and built at Schichau, are fine boats of 620 tons displacement and 35 knots speed, mounting three torpedo tubes. The Turks also have nine torpedo boats of from 100 to 165 tons displacement and of 26 to 27 knots speed.

The Turkish fleet lost no time in getting into action; and already it has done considerable bombardment of Russian ports,

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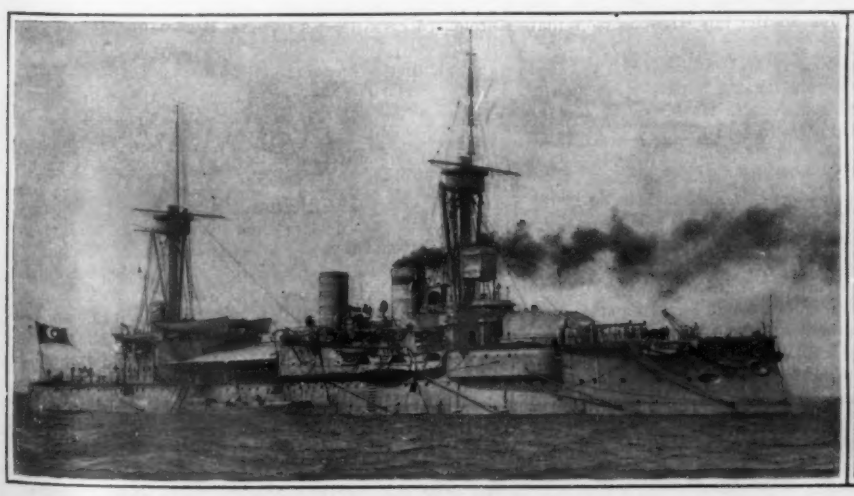
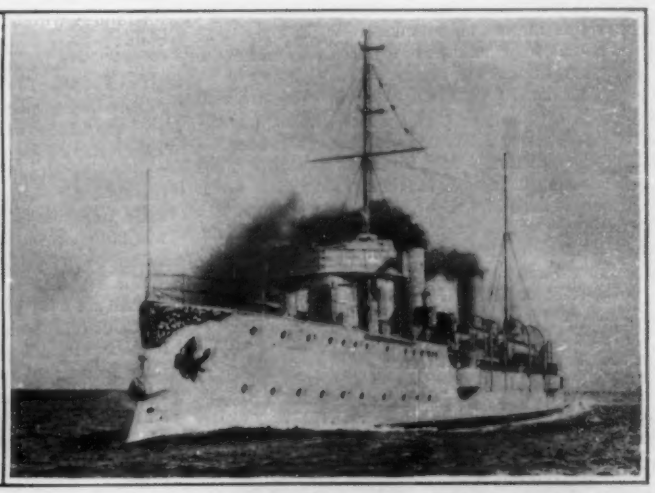


Date, 1893. **Tonnage,** 10,000. **Speed,** 17 knots. **Belt,** 15¾-inch compound armor. **Guns:** Six 11-inch, eight 4-inch. **Torpedo tubes,** 2.

Battleship "Hairredin Barbarosse" (formerly "Kurfurst Friederich Wilhelm").



Date, 1906. **Tonnage,** 775. **Speed,** 22 knots. **Guns:** Two 4-inch. **Torpedo tubes,** 3.

Torpedo gunboat "Peik-I-Shevket."

Is Germany Self-Sustaining in War?

Ability to Provide Food and War Materials from Domestic Sources a Great Element of Her Strength

By Benjamin Baker

GERMANY'S extraordinary isolation in both the military and commercial relations of the empire has been fully noted in the daily press; and much has been made of the fact that she usually imports about a third of the wheat she uses, and all of certain textile materials, such as raw cotton and silk. It has been confidently predicted that the war will result in the ruination of her foreign trade and the utter prostration of her industries; while it seems to be assumed, without much evidence of any careful study of the situation, that in the matter of food supplies particularly, the war will quickly lead to scanty fare, if not to widespread hardships, from actual lack of food.

But this notion, while it has something to support it, fails to grasp the fact that Germany can support herself on her home resources for fully a year, and that this capacity for self-support in the face of a universal embargo has a very high military value. It is probably true that long before next August, if the war were to last as long as that, the people of Germany would be put to many shifts from their usual mode of living. They might, for instance, have to learn to eat a greater part of their annual production of some two billion bushels of potatoes which are now mostly used in the production of industrial alcohol. In the absence of imports of raw cotton, they would undoubtedly have to economize on stockings, underwear, and shirts. But they could very well do these things, and many others that necessity might require, without any real bodily suffering. The South, in our Civil War, cheerfully endured privations much greater than any of a material sort likely to afflict the German people in the course of a year's war.

Germany is still largely an agricultural country, though the prominence of her manufactured goods in American markets has probably led most of us to think of her as mainly a commercial nation. Nine tenths of her area of 208,000 square miles, inhabited by some seventy million persons, is productive. Her arable lands, including vineyards and other cultivated tracts, total over 65,000,000 acres, or practically half the entire area of the country. At a pinch she can feed herself for a long time. She is similarly self-sustaining, but more so, in the matter of all military supplies and appliances. Besides the cultivated lands, grass meadows and permanent pastures take up over 21,000,000 acres, while woods and forests occupy 35,000,000 acres. In 1910 over 10,000,000 persons were engaged in agriculture on a total of five and three quarters millions of separate inclosures or farms. Many of these farms were very small, but the enumeration takes in none under three acres in area. The largest estates are in East and West Prussia and in the Prussian provinces of Pomerania, Posen, and Saxony; while small farms are the rule in the Prussian Rhine province, in Baden, and in Wurttemburg. It is noteworthy that the agricultural population, living by farming, and living on the farms, is only about a million less than the total number of persons engaged in manufacturing pursuits, including the textile industries—or ten millions for farming against eleven millions for all manufacturing.

Cereals the Food Problem for Germany.

The statistics of home production and of imports of cereal foodstuffs probably present the German food situation in a somewhat worse light than the facts as to all the food supplies justify. Germany is an exporter of beef in large quantities to both England and France, yet in the current discussion of the food issue this fact, and its significance to Germany under the present circumstances, is wholly overlooked.

Germany's home production of foods from the soil last year, 1913, totaled 84,783,000 metric tons, the metric ton being the unit for all the official German statistics of production. The metric ton equals 2,204 English pounds, or nearly the "long ton" with which Americans are familiar. The figures in metric tons can be roughly converted into bushels by multiplying the figures in tons by 37.6. This would give the cereal production of last year, plus potatoes, at about 3,285,000,000 bushels, or 47 bushels per capita for the entire population of the country. From a dietetic point of view, the proportion of potatoes is of course too high. In detail the crops for 1913 were:

	Metric Tons.	Bushels.
Wheat	4,656,000	176,000,000
Rye	12,222,000	462,000,000
Barley	3,673,000	139,000,000
Oats	9,714,000	366,000,000
Potatoes	54,121,000	2,000,000,000

Imports of grains in 1913 are given in the German official figures by their values in marks; the values can be converted into dollars by dividing the figures in marks by 23.8, that being the value of the mark in our currency at the par of exchange. A rough method is to divide the figures in marks by four, to get the value in dollars. The imports last year were:

	Marks.
Wheat	429,000,000
Rye	44,000,000
Barley	407,000,000
Indian corn	106,000,000
Total	986,000,000

As given by the U. S. Department of Agriculture, the cereal imports of Germany were:

	Bushels.
Wheat	69,235,000
Barley	107,873,000
Corn	34,966,000
Oats	16,767,000
	Pounds.
Rice	474,747,000

About 7,000,000 bushels of rye were exported in the same period.

The tables of production and of imports of cereals show that Germany now imports about one fourth of the wheat she uses, and naturally all the rice, the imports of rice being somewhat larger than those of wheat. In the period from 1900 to 1905, both years included, the four cereal crops named in the first table above averaged about 840,000,000 bushels, and during the same period the imports of cereals averaged about 170,000,000 bushels, or nearly one fifth of the home production. Barley is imported largely from Russia, little of this Russian grain being fit for the manufacture of beer. Possibly there may be relief in this direction in a much diminished brewing of beer, releasing the home supply, or much of it, for a different form of consumption.

Tabulating the production and import of cereals, however, does not wholly clear up the details of the food situation of Germany, because of the fact that, while the total imports of foodstuffs last year amounted to a little over seven billion marks, the cereal imports given in the second table above total less than one million marks, exclusive of rice; and with rice included, the total will hardly rise above the million mark, or one seventh of the total food and agricultural imports.

Fish, which has been generously imported, will be largely cut off by the war. The total value of the German fisheries in 1912 was about a billion dollars, and this was supplemented by imports mainly of cod and herring. Most of this came from the North Sea, and its failure will be felt in the large seaports on that coast.

Cattle Industry Makes Exports.

Cattle raising is a very important part of Germany's production, furnishing an excess which has supplied a growing volume of exports to both France and England. The retention of the beef formerly exported will of course add considerably to the home food resources of the empire. Cattle raising is mainly carried on in the south and southwest of Germany, the pastures in the foot-hills of the Alps supporting large numbers of animals.

Horse breeding is another animal industry that is carried on with great success both as to numbers and as to quality of animals. The main centers for this industry are in East and West Prussia, which is a great plain region; the marsh districts of the Elbe and Weser, to the northwest, and some parts of Westphalia, Oldenburg, Lippe, Saxony, and Upper Silesia. The stud farms of Trakihnen in East Prussia, and Graditz in the Prussian province of Saxony, have a European reputation.

Sheep have been declining pretty steadily in Germany since 1860, the number having fallen from 28,000,000 at the earlier date to some five or six millions now. This represents not only a decrease in home meat production, but also in wool supply, a large part of which now has to be imported for the textile industries.

How long can the German Empire feed its population from domestic products alone? Long before the outbreak of the present war, the question was much discussed not only by Germans, but by French and English writers as well. Dr. Carl Ballod of the University of Berlin took a distinctly pessimistic view of Germany's ability to feed herself in the Preussische Jahrbücher. *His article was a reply to Count von Moltke, who published far more optimistic views in the same periodical. In the article appearing on this page, Mr. Benjamin Baker, after carefully examining statistics, shows that Germany can support herself for fully a year.*—EDITOR.

Plenty of War Material and Plants.

As to war material of every sort, Germany is entirely self-contained. Her great shipyards and the enormous armor and gun plant of the Krupps are known the world over. She can not only build the machines of war, but she has the raw materials within her own borders. Up to recent years Germany imported Swedish iron for the making of steel by the Bessemer and open hearth processes; but since the Bessemer process has been modified to make use of phosphorus-bearing iron ores, Germany has made her steel from the abundant ores of Lorraine and Luxemburg, and has built up a large export trade in bridge and railway material, which she has sold largely to Russia and France. In engines and machines she ranks next to England, and her exports of these cover the world.

The mineral production of Germany in 1912, in metric tons, was:

	Tons.
Coal	174,875,000
Lignite (brown coal)	80,935,000
Iron ore	27,200,000
Zinc ore	644,000
Lead ore	143,000
Copper	974,000
Rock salt	1,296,000
Potash	11,161,000
Other products	582,000

Total value, $564,000,000.

Here are all the raw materials for guns, armor, and explosives with the exception of cellulose; possibly there would be a shortage in the lead supply if the war lasted indefinitely. The large imports of copper, which last year reached the value of 351,000,000 marks, might suggest that the cutting off of this outside supply would affect war equipment in some way. If we assume that the imported copper cost 13 cents a pound, the imports amounted to about 640,000,000 pounds, or somewhat less than one third of the domestic production. The unlikelihood of the suspension of copper imports affecting the supply of war material appears when we find that Germany's exports of copper wire last year amounted to a billion and a third of marks. This is four times the value of the copper imported, and strongly suggests that all the copper imported was brought in for manufacture and subsequent export. It is interesting to note that copper wire represented the highest value of any single article or class of articles exported.

Government and Private Revenues Cut.

The cessation of imports, if it continues long, will cut off a government income from customs duties which amounted in 1911 to $212,000,000, and would be more than that this year. The greater part of the imperial income, or at least half of it, is derived from other sources, such as various excise taxes and the income of the imperial railways in Alsace and Lorraine. The cost of the recent expansion in the size of the army has been met by levying special taxes on the German States and on the property holdings and incomes of individuals. A prolonged cessation of commerce will cut off a considerable total of private and banking income through the interruption, or loss, of interest on foreign loans and investments, and this loss will lessen the taxpaying capacity of the people.

A larger loss in taxable resources will come from a prolonged cessation of the industries which depend on the export trade. Germany imports all her raw cotton and silk and a considerable part of her wool for manufacture. The early cessation of the textile industries is therefore inevitable, and this will add hundreds of thousands of idle people to the other great numbers thrown out of work by the failure of the export trade.

Calcium Bread

THE importance of calcium in the human dietary is discussed in a recent article by O. Loew, who urges the desirability of supplying this element, when needed, as an ingredient in bread. The author states that only those adults who use milk and vegetables in abundance secure a sufficient amount of calcium, while those who eat much meat and get their carbohydrates in the form of bread, potatoes, and beer do not. The amount of calcium in the diet appears to be related to certain pathological conditions, such as arteriosclerosis. It is proposed to use in bread-making calcium chlorid and a commercial preparation called "calcifarin," made from rye flour and calcium chlorid. The author thinks it more practical to add calcium to fine flour than to attempt to persuade the public to adopt whole-grain bread.

Campaigning in Winter

Climatic Factors in the European Struggle

THAT the coming winter will add greatly to the difficulties and hardships of the warring European armies cannot be doubted. It is true that improvements in military methods and equipment have made impossible such colossal horrors as those attending Napoleon's retreat from Moscow or even those incidental to the operations of the allied armies in the Crimean war; yet the rigors of winter are still a factor to be reckoned with in both the strategical and the humanitarian aspects of war.

As to the sufferings entailed upon the soldiers, a few illustrations will show that these are still inevitable. Of the fighting in Manchuria in January, 1905, during the Russo-Japanese war, Sir Ian Hamilton says: "Horsemen galloped about the field with the foam and dripping sweat of their horses changing into a crust like snow and long dangling icicles. The Fifth Division—only seventy yards distant from the Russians, near Heikoutai—had the choice between frost and fire. When they stamped their feet to keep life in them, the Russians, expecting an advance, fired on them. When the Japanese remained quiet they lost their toes. Four hundred of them were found to be suffering from *tosho* (frost-bite) the next morning."

An episode in the defence of Plevna in 1877, which might well be repeated to-day, is recorded by Capt. W. V. Herbert: "The sentry service in our own redoubt," he writes, "as well as throughout the camp, was of a cruelly severe character in the rigor of a Bulgarian winter. The original four hours had to be reduced to two, and then to one hour. Fixed, almost buried alive, in a hole 4 feet deep, with the upper part of the body exposed to the bitter blasts, the lower embedded in the frozen ground, unable to move (the slightest attempt at a trot, the very act of stepping out of the hole, attracted the enemy's bullets), insufficiently fed, compelled to exercise ceaseless vigilance, struggling against the dangerous drowsiness engendered by frost, the men looked upon sentry duty as the last refinement of torture."

Of the sufferings and mortality of wounded soldiers left lying for hours in the open in severe winter weather it need only be said that "progress" in the art of war has made no change in immemorial conditions—except an enormous increase in the number of sufferers.

From the strategical point of view wintry weather is not an unmixed evil. In western Europe the worst weather for military operations prevails in autumn, when the rainfall is at its maximum. Cold weather sets the roads, makes the sodden fields practicable for marching, and bridges over small bodies of water. Only in the mountain passes are these advantages offset by the obstruction due to snow. In the interior of the continent—e. g., on the East Prussian and Austrian frontiers—heavy snowfall occurs even over the plains and lowlands, and opposes an obstacle to military movements. Here, also, the intense cold freezes over the larger rivers; thus the Vistula is normally frozen at Warsaw from late December to early March. On the other hand, when not frozen over but filled with floating ice, these streams become impassable even by boat.

Again, it is difficult or impossible to dig trenches in frozen soil, such as may be found in the dead of winter in the interior of the continent. Under such conditions armies have, however, sometimes used blocks of ice to good advantage in building breastworks.

Strange to say, the circumstance of being accustomed to a cold climate does not appear to give any decided advantage to troops campaigning under winter conditions. T. M. Maguire, in his "Outlines of Military Geography," says: "When the theater of operations is entered, nothing is of much importance except military organization. The inhabitants, however well used to the climate, will perish if unprepared, while the invader, if provided with all requisites of clothing, food, and drink, will thrive." In the Balkan campaigns of 1877, the Russians suffered more from cold than from the Turks. Even the supposed superior stamina and military prowess of the inhabitants of cold, as compared with those of warm climates, is largely mythical, as may be seen by comparing the very unequal warlike qualities of the different races of northern India, who live under nearly identical climatic conditions.

The two main theaters of the present war differ greatly from each other in their winter climates. Western Europe enjoys comparatively mild winters, under the influence of prevailing westerly and southwesterly winds from the Atlantic Ocean, which, like all large bodies of water, has but a small range of temperature from summer to winter. The climate is, however, very moist, so that a moderate degree of cold produces much discomfort. Cloudy weather prevails considerably more often than in any part of the United States, except perhaps the region of the Great Lakes and the extreme North Pacific coast. As we go inland we find no abrupt change of conditions, as there is no large range of mountains running parallel to the Atlantic coast, to form a climatic divide; very gradually, however, the climate becomes more continental, and the present eastern theater of the war lies in a region that is intermediate in climate between the marine conditions of the western coast and the truly continental climate of central Russia.

The snowfall increases generally from west to east; not because of an increase in the total precipitation (rain plus snow), for this actually decreases, but because, with lower temperatures, a larger proportion of the precipitation takes the frozen form. The snowfall also increases markedly with altitude.

Both regions are subject to rapid and frequent changes in temperature under the influence of barometric depressions passing from west to east, although, especially in the eastern region, these are somewhat less frequent than in the northeastern United States, as the main European storm-tracks lie north of the war zone.

With respect to temperature and snowfall, one might say in very general terms that the western theater of war has the climate of South Carolina, while the eastern has that of Iowa.

A few comparisons of mean midwinter (January) temperatures may be instructive: Ostend, 39; Brussels, 37; Liége, 37; Luxembourg, 34; Aix-la-Chapelle, 36; Danzig, 28; Posen, 29; Königsberg, 26; Warsaw, 26; Prague, 30; Lemberg, 24.

New York, 30; Boston, 27; Chicago, 24; St. Louis, 31; St. Paul, 12; Denver, 29; New Orleans, 53; San Francisco, 50.

Dual-engined Aeroplanes

FIVE years or so ago the engines available for aeronautical purposes were scarcely distinguishable from motorcar engines. The evolution that has since taken place has been one of the most remarkable chapters in the history of aviation. To-day, the aeroplane motor stands in quite a distinct class by itself, and we can make our choice not from one or two, but from a dozen or more types. The improvement of the design is now a matter of detail, and is being pushed on with vigor. Even within the last year the progress made has been great. For one thing, the aero engine is gradually being made more efficient as regards its consumption of fuel and oil. For another, it is being made more trustworthy and less liable to fail at a critical moment and precipitate a "forced descent." Nevertheless, "engine trouble" is still the most frequent cause of untoward events in the aviation world, and from this we must recognize that good on the whole as the aero engine of to-day undoubtedly is, it is still far from perfect. From all points of view, and from the military especially, the possibility of the aviator's having to make an untimely landing is disquieting and a source of annoyance, and as a way of reducing this possibility in a great measure it has frequently been proposed to duplicate the power plant. Machines of this type are, in fact, already in existence or under construction, and we may expect that in the immediate future dual-engined aeroplanes will be less than exceptional.

In a way, the proposal seems like a counsel of despair. It implies an apparent lack of faith in the possibility of producing a motor much more trustworthy than those in use on the aeroplanes of to-day. To carry an unreliable spare engine through the air in order that it may be at hand to replace another, equally unreliable, in the event of a breakdown on the journey certainly does at first sight appear like the last resort from a desperate position. It is merely a temporary solution. For the time being the aeroplane has overtaken its engine. If the progress that has been made in artificial flight is not to receive a check, there must be available a means of propulsion from which the chances of failure at a critical moment have been eliminated to a much greater degree than they are at present in even the best of our aero engines. The whole trend of design demands it. We are confronted with this need for a more trustworthy power plant on every hand, for the size of machines and the length of journeys are increasing rapidly, and the larger the craft and the longer their flights the more vital is it to avoid an unintentional landing and the bigger is the stress put upon the motor. It is on the motor that the progress of the aeroplane in the next few years will chiefly depend. The engine builders recognize this quite clearly themselves, and admit the necessity of meeting the demand by approving, for the time being, of the duplication of the power plant. When the improvement of the engine comes, as it certainly will, we may not, however, see the dual-engined aeroplane consigned to the museum of antiquities. The type will probably persist, for apart altogether from the question of guarding against breakdown, much can be said in favor of fitting two engines in place of one. Of primary importance is the matter of weight. Two engines may actually weigh less than one engine for the same power. With the larger and larger horse-powers now being put into aeroplanes we have almost, if not already, reached the point where weight will be saved by using duplicate engines. Again, dual engines being most naturally arranged side by side and not in tandem, permit of keeping the *nacelle* free from much that encumbers it when a single engine is arranged on the center line of the machine. The pilot's comfort and safety are thereby enhanced. With dual engines, too, we would naturally have dual propellers with their attendant advantages and without the disadvantages of chain or gear driving. On this point we may express the opinion that as the size of aeroplanes increases, the necessity for reducing the over-all diameter of the propeller will, in any event, lead manufacturers to return to the dual propeller arrangement, and that to save the loss arising from some form of transmission drive each propeller will normally be direct coupled to a separate engine.

It appears, then, that what to-day is a temporary solution propounded for safety's sake will come to be adopted for the sake of efficiency and convenience as standard practice. It must not, however, be overlooked that safety is at least of as much importance as efficiency and convenience. In adopting the dual engine arrangement for the latter reason we should not neglect to take advantage of the increased safety that the system makes possible.

Thus, while for the sake of efficiency and convenience we may divide the power equally between two motors, we must for the sake of safety see that either motor is capable of driving and sustaining the machine when the other is idle, as by breakdown. Some difficulty may be experienced in carrying this out, for it obviously means that the machine should be able to fly and be controllable at half power, or that normally the two engines when running together should each be considerably throttled down. The latter seems the better solution, for it is always desirable to have a good margin of power in hand. The mechanical difficulties introduced by the efficient and safe dual drive are not very serious, and have, we know for certain, been surmounted in at least one design. What is required is a simple means whereby either engine can drive either or both propellers. This has been accomplished in one design by a simple system of gearing. Finally, as the breakdown of one engine will have a smaller and smaller effect on the behavior of the machine as a whole, as the number of separate engines and propellers gets greater and greater, we may expect that ultimately aeroplanes will be driven not by two engines requiring some change mechanism between them and their propellers, but by several small engines, each direct coupled to a separate propeller.—From *The Engineer*.

	Longitude East	October		November		December		January		February		March		April	
		Days	Depth (Ins.)	Days	Depth (Ins.)	Days	Depth (Ins.)	Days	Depth (Ins.)	Days	Depth (Ins.)	Days	Depth (Ins.)	Days	Depth (Ins.)
Posen	16° 56′	0.1	...	0.7	...	13.9	0.8	17.8	2.2	15.1	1.1	7.4	0.4	0.6	0.08
Bromberg	18° 0′	0.4	...	2.7	0.4	16.6	1.0	17.2	2.3	16.0	1.7	7.4	0.4	0.5	...
Königsberg	20° 30′	1.1	0.04	4.6	0.2	19.4	1.6	21.9	3.3	19.3	4.0	10.9	1.0	0.8	0.04
Memel	21° 8′	0.3	...	1.8	0.1	13.5	1.5	19.4	3.1	19.3	4.3	11.4	1.7	0.1	...
Marggrabowa	22° 30′	1.1	0.04	6.9	0.3	25.5	2.6	27.2	4.6	25.8	7.1	20.6	3.7	1.9	0.08

Duration and depth of the snow-cover in eastern Germany during an average winter.
This table shows the number of days the ground is covered with snow and its average depth at typical places.

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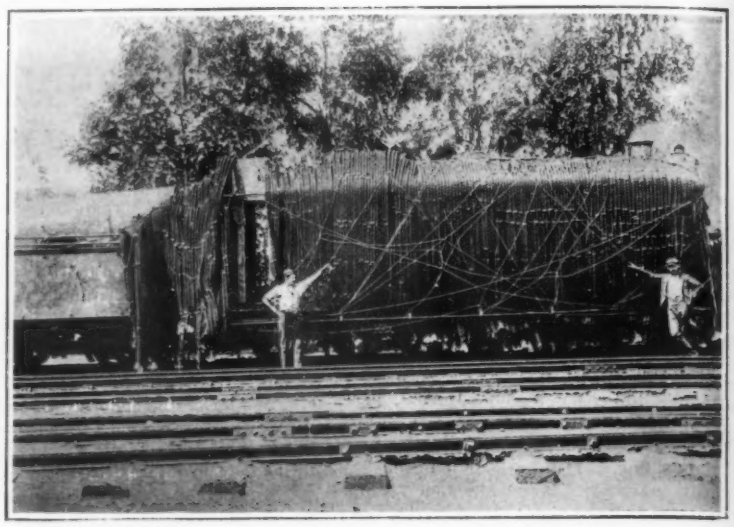
German trench protected from shell fire by wire coils.



Photograph by Paul Thompson

Cable armor on a British locomotive in South Africa.

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The flooded Ypres Canal. Note the shelters in the bank.

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French troops bivouacked in the streets of Paris.

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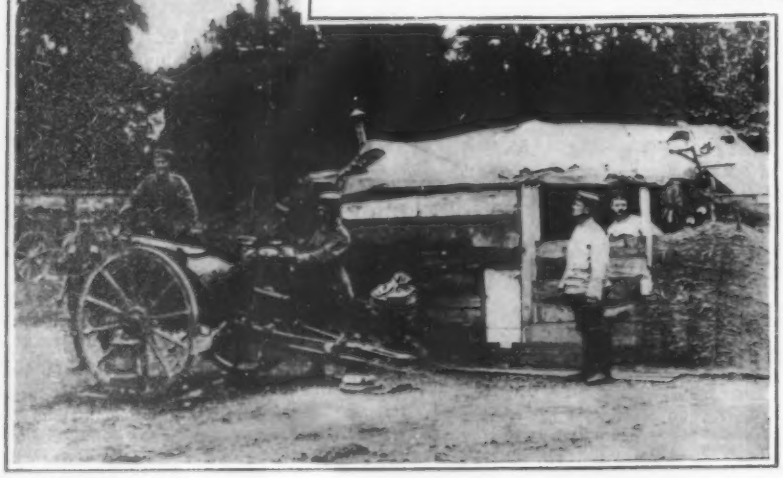
Indian troops in the New Forest watering their mules.



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German field wireless telegraph station at work.

Photograph by Edwin Levick

French dragoons shoeing their horses by the roadside.

EVERYDAY WAR SCENES AND OTHER PICTURES OF INTEREST

Photograph by Fran Thompson

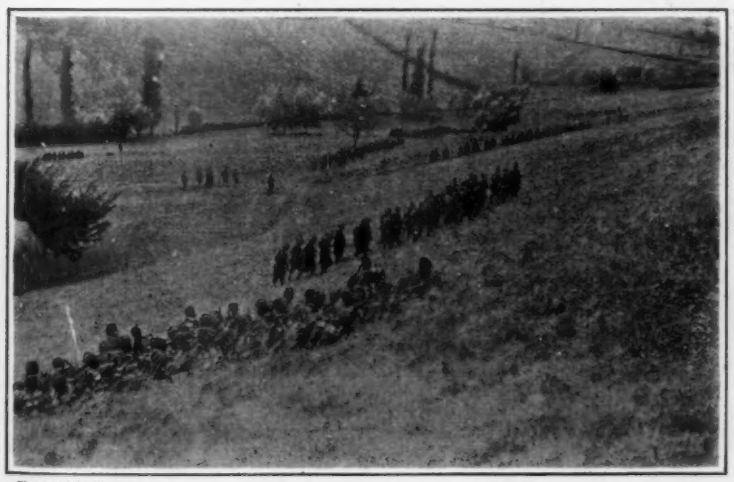
The second battalion of the famous London Scottish rehearsing a charge.

Photograph by Branger

A patrol of French dragoons reconnoitering.

Photograph by Branger

German infantry manning a trench.

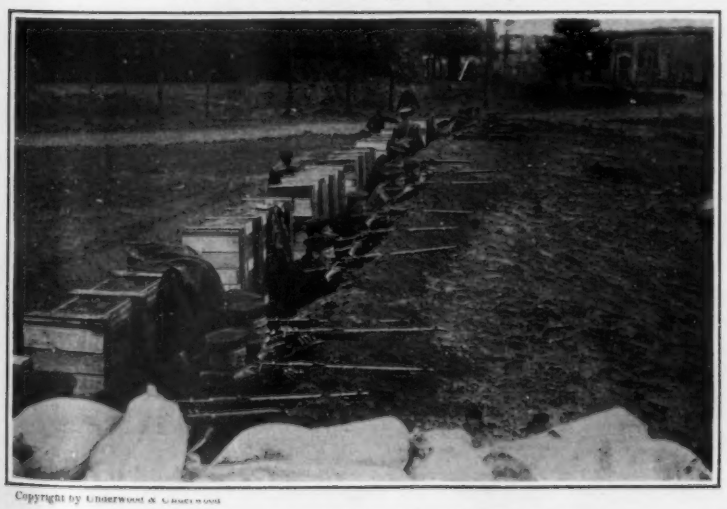


Photograph by Branger

French infantry marching to the firing line.

Photograph by Branger

Belgian riflemen defending the approach to a village.



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British marines fighting from the trenches.

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A company of Russian soldiers on the march.

A FEW OF THE VARIED TYPES OF SOLDIERS IN THE EUROPEAN WAR

Mining and Countermining of Fortifications

Capturing a Fortification by Trenches and Tunnels

THE Germans and Austrians with their 11-inch and 12-inch howitzers and their 16½-inch siege mortars, have found a new and very speedy way of reducing fortifications—always provided that the troops of the enemy permit them to bring this heavy artillery within range of its objective.

Not all of the nations engaged in the World War, however, are provided with such heavy pieces; and if any one of them attempted the reduction of a first-class fortification, they would have to resort to the time-honored method of attack by open approach trenches and by tunnels, driven below the very walls of the fortification itself.

In reducing a strongly fortified place the first step is to cut off communication with the outside world. A rapidly moving, comparatively small force, followed by reinforcements, is thrown entirely around the position, the force being beyond range of its artillery, or say, about three miles from its main lines of defense. This is known as the line of investment. It will be held in stronger force at some portions of the line than others; but everywhere it will be sufficient to cut off all exit from or ingress to the fortification. The zone of investment is entrenched, communication by telegraph and telephone is established between the different sections of the investing line, and communication is also established to headquarters.

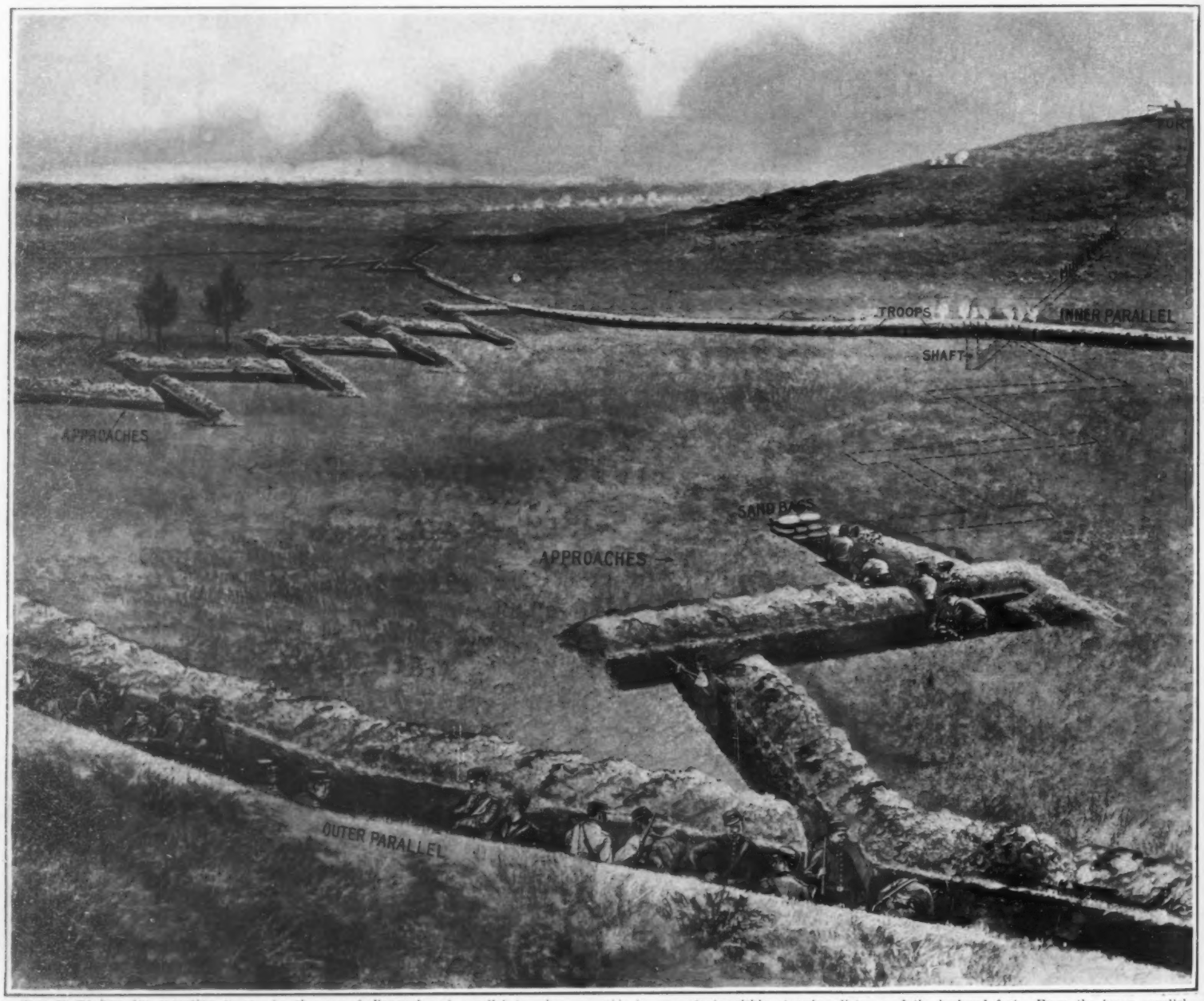
When the line of investment is complete, the attack is pushed forward from one or more positions, the selection of which is determined by the following concomitant conditions: It must afford a good communication with the base; it must offer the best topographical conditions for emplacing the siege batteries, and for working up to the fortification under natural cover of the country; it must offer the most favorable ground for the construction of siege railways; and the selected line of approach must be favorable for digging operations.

When the direction and location of the attack have been decided, sites for the siege batteries are selected at distances of from three thousand to five thousand yards, according to power and range of the siege howitzers available. The attack on the fortress then commences, and the artillery fire is maintained until that of the defense has been silenced or at least partially smothered. The attack then attempts to gain ground toward the fortress; outposts are advanced and an effort is made to control the country in front for a sufficient distance to make it possible to dig the first trench parallel to the line of investment, if it be possible, within about 1,200 yards of the point to be attacked. The position chosen for this trench is reconnoitered, and at night an attack is pushed forward in order to drive the enemy in as far as possible from the position thus selected for this trench, which is known as the first parallel. In the dusk of the evening, a party, consisting of an engineer officer, a non-commissioned officer and a private for each fifty yards of the proposed length of parallel, move forward, and they carry with them tracing tapes of white cotton fifty yards in length. The officer carries also a compass to obtain the proper direction, and the line of the parallel is then "traced" or marked out with the tape.

Usually, if the fire of the defense is vigorous, the outposts commence work on the first parallel, by digging short lengths of it, which are afterward extended to a connection with each other. In the Japanese siege operations at Port Arthur, the parallels were about 6 feet in depth and 14 feet in width, or of sufficient width to permit troops to march therein four abreast.

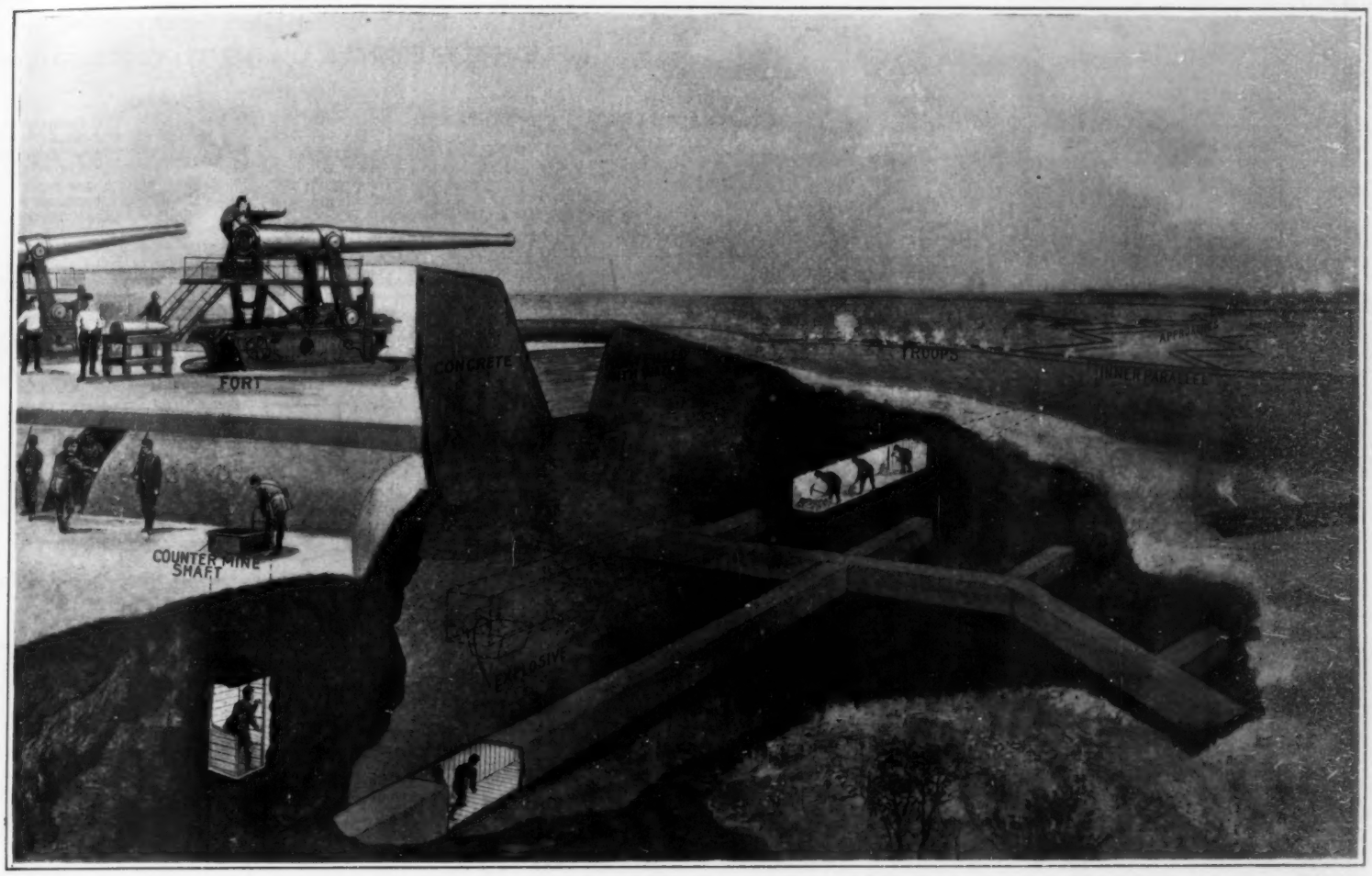
When the first parallel has been completed and occupied, two or three lines of zigzag trenches or approaches are dug in the direction of the fortress, until a distance of about six hundred yards from the objective has been reached, and here a second parallel is constructed and occupied. From the second parallel further advance is made by approaches, until a position has been reached within about half the distance between the second parallel and the fortress. Here the third parallel is constructed at a distance from the objective of say about two hundred and fifty to three hundred yards.

The excavation of approach trenches, under fire, is different from the ordinary parallel trench work, in that it proceeds progressively from its outer ends, and the men are fairly well protected from the fire while digging. The technical name of these approaches is "saps." The work is done by specially trained men known as "sappers." The head of the trench toward the enemy is known as the "sap head," which is pushed forward by an officer and eight "sappers," who work in two reliefs. The sappers are protected at the end of the trench by a pile of half-filled sandbags, maintained sufficiently high to form a two-foot high parapet. Number one "sapper," kneeling, undercuts the end of the trench and brings down the earth. Then number two takes his place and shovels the loose earth away, which is thrown out on the side of the approach next the



This shows how the investing troops, by the use of diagonal and parallel trenches, are able to concentrate within storming distance of the besieged fort. From the inner parallel a tunnel is driven below the outer wall and a charge of high explosive serves to breach the fort and permit the storming party to make its final rush.

Capturing a fortress with pick and shovel.



This view shows the besiegers driving a mine gallery below ground from the inner parallel of their trench system to a point below the fortification. Below it are the countermine galleries of the defense.

Mining and countermining in the attack and defense of a fortress.

enemy to afford protection; or, if the approach is to be covered, the material is carried to the rear on stretchers (as in the case of the Japanese approach to Port Arthur) or by other means, and is deposited out of sight of the enemy. As the "sap head" is advanced, the sandbags are pushed forward by rolling them over by hand, or by the use of a fork, and the undercutting and shoveling are proceeded with until a diagonal trench a hundred feet or so in length has been dug, say in a lefthand direction. Then the approach is driven in a similar way to the right, and so on, until the required distance has been gained.

When the third parallel, within charging distance of the fortification has been dug and occupied, it may be found that the base of the fortress is too high or difficult for a direct attack with scaling ladders or the other storming equipment. In such a case, it will be decided to make a breach in the wall of the fortress by blowing it up. This operation is achieved by what is known among military men as mining, which consists in driving a horizontal tunnel until it reaches a point below the fortress; placing at the farther end of it a charge of explosive; and blowing a breach through which the attacking troops can enter. These tunnels are known as "galleries," and as the work must be expeditious, they are made as small as possible, the common size being three feet in width by four and one half feet in height. To prevent caving in, they are usually timbered or lined, the lining being prepared beforehand, and cut to exact sizes, so that it can be put in place rapidly as the work of excavating advances. When the gallery has been carried to the desired point below the fortress, a heavy charge of high explosive is placed at the end of it in a prepared chamber, and everything is ready for the final great attack.

The storming of the fortress will generally be done at night, and it will be preceded by a violent and unceasing bombardment from the siege artillery to the rear, the object of which will be to work all possible damage with high explosive shells, keep down the fire of the defense, and generally shake up its *morale*. Meanwhile the picked troops selected for the first rush will have passed, by way of approaches, to the third parallel, confronting the fortress; and back of them in the outer parallel and approaches will be the reserves.

When everything is prepared, the mine is detonated, and through the breach made in the walls or parapets, the storming party makes its rush from the third parallel, being strongly supported by the troops in the approaches and parallels to the rear.

In view of the great peril to the defense of the approach by mining, a system of defense known as countermining has been evolved. In countermining a shaft is sunk by the defense within the fortification, and from this a main gallery leads out to a transverse gallery from which a system of small radiating galleries is constructed, covering the terrain which to military eyes appears to present the most favorable direction for attack. In many permanent fortifications the countermines are dug at the time of the construction of the fortress and form part of its permanent defenses. At other times they are commenced only when the direction of the attack has been approximately located by the defense. Men are sent out into the counter-mine galleries, and they listen for the slightest sound of the working tools of the attack. When the location of the enemy has been determined, explosives are placed in the countermines and the working galleries of the enemy are blown up. It is interesting to note that in the present field operations mining and countermining are reported to have been resorted to by both the Allies and the Germans in the open field entrenchments in France and Belgium.

Detonation of a 12-inch shell filled with high explosive and buried six feet below ground.

Photograph by Paul Thompson

Digging trenches of the type that is secure against front and cross fire.

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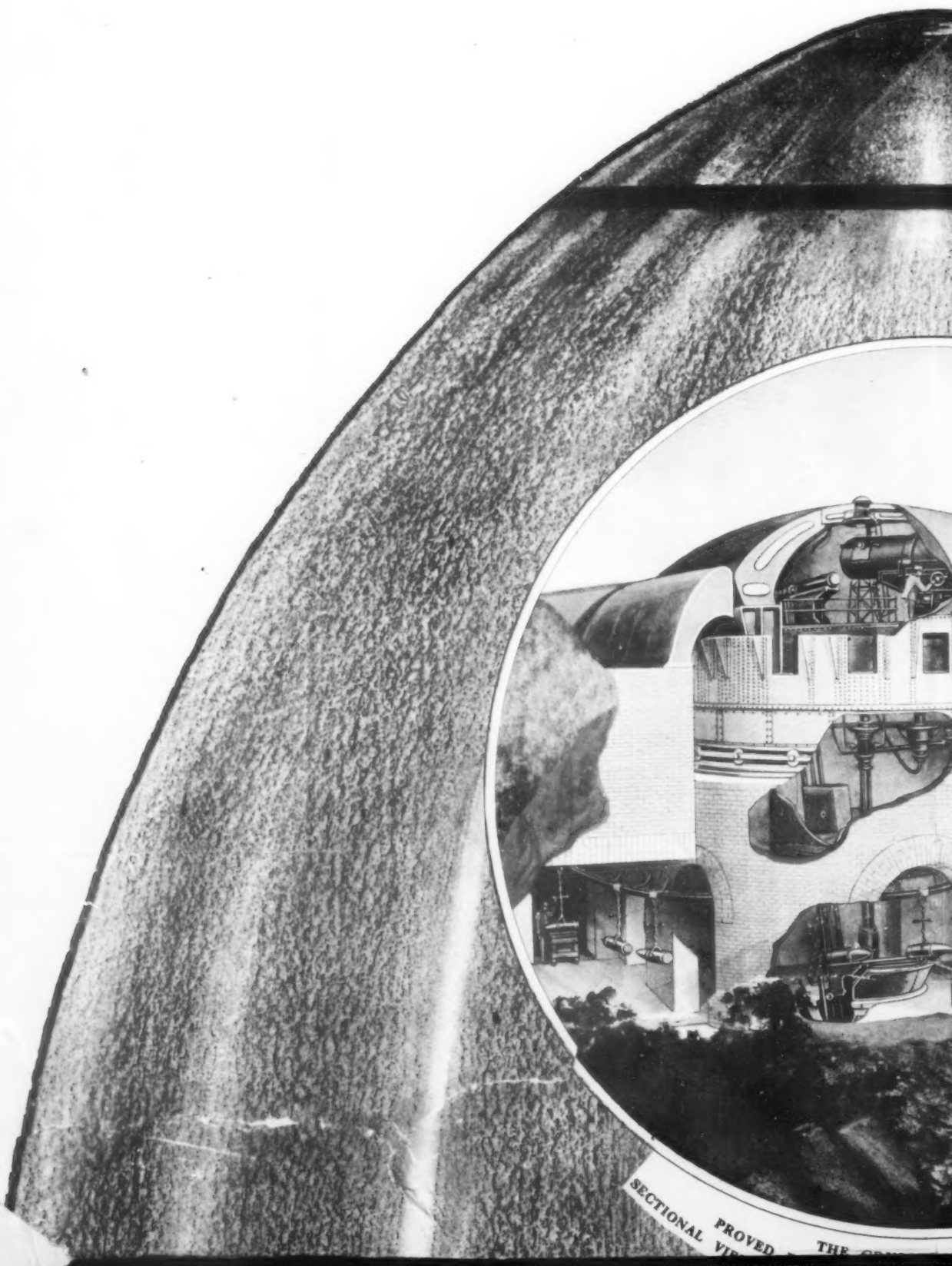

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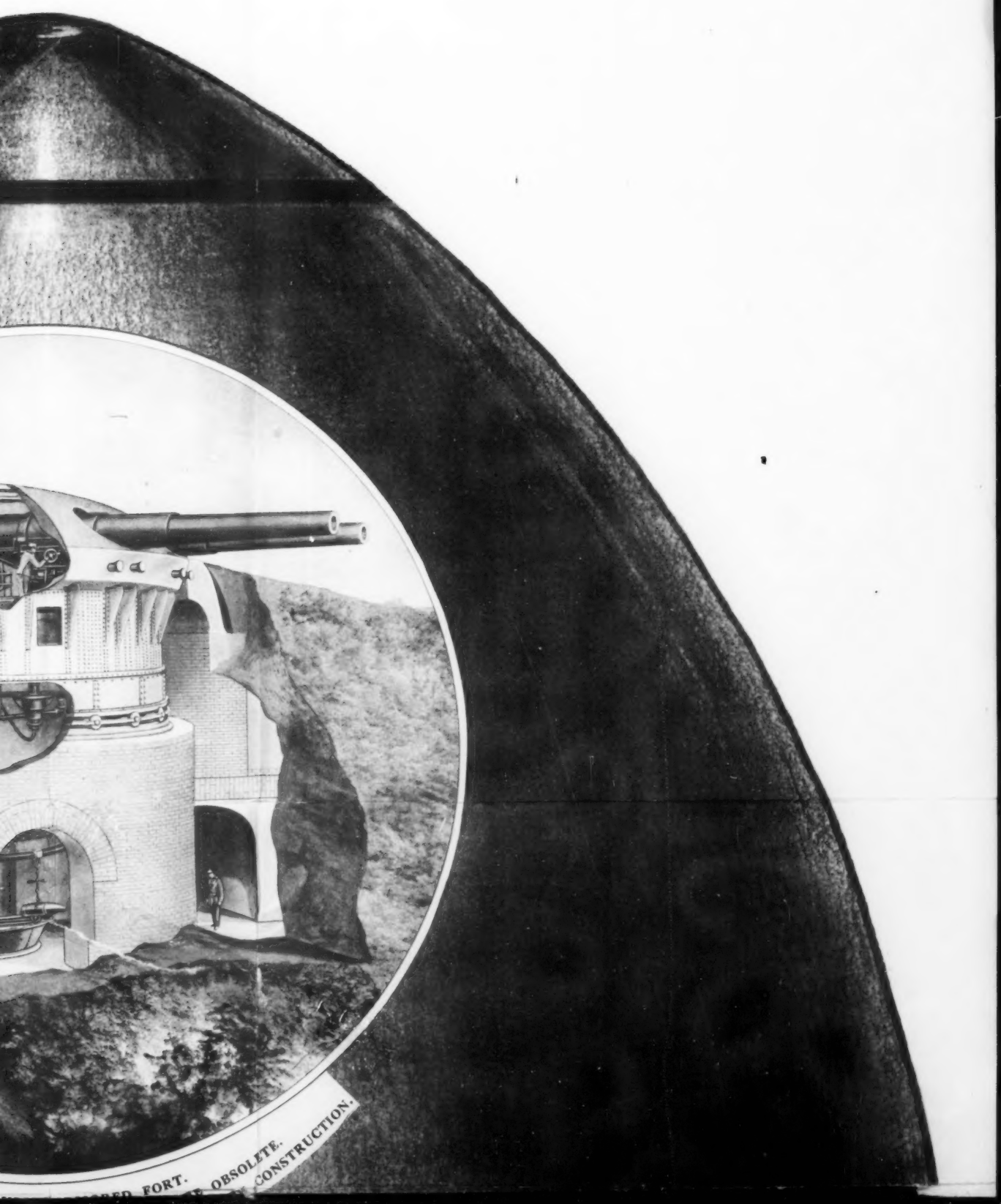
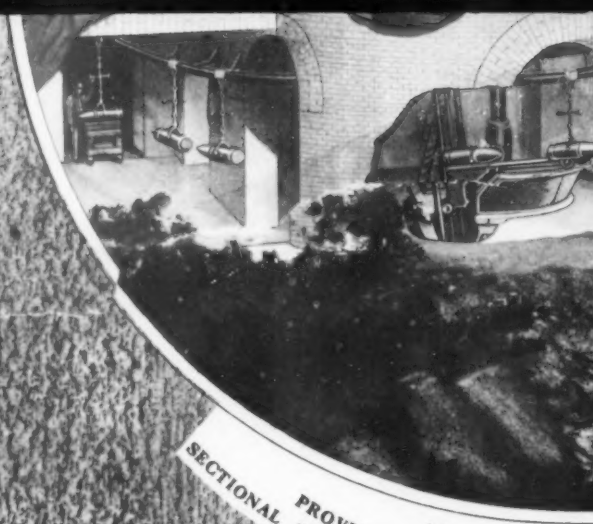


ED FORT. OBSOLETE.
CONSTRUCTION.

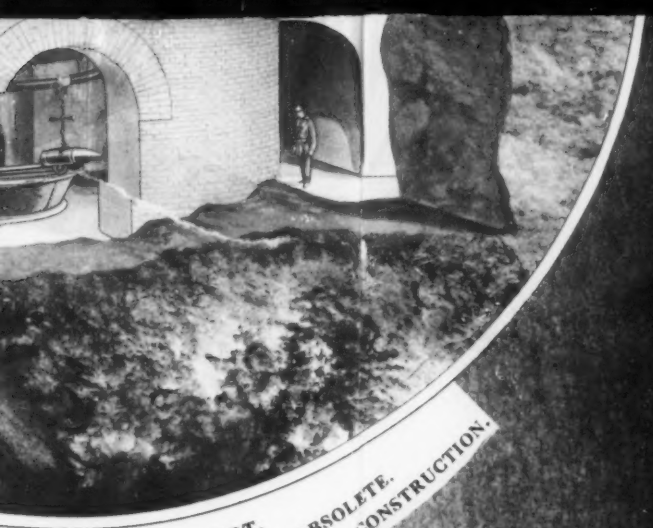


PROVED BY THE GRUSON
SECTIONAL VIEW SHOWING MODERN
TURNTABLE

EFFECT OF GERMAN HEAVY SIEGE GUN FIRE ON LIEGE ARMORED CUPOLAS.

Photograph by Paul Thompson

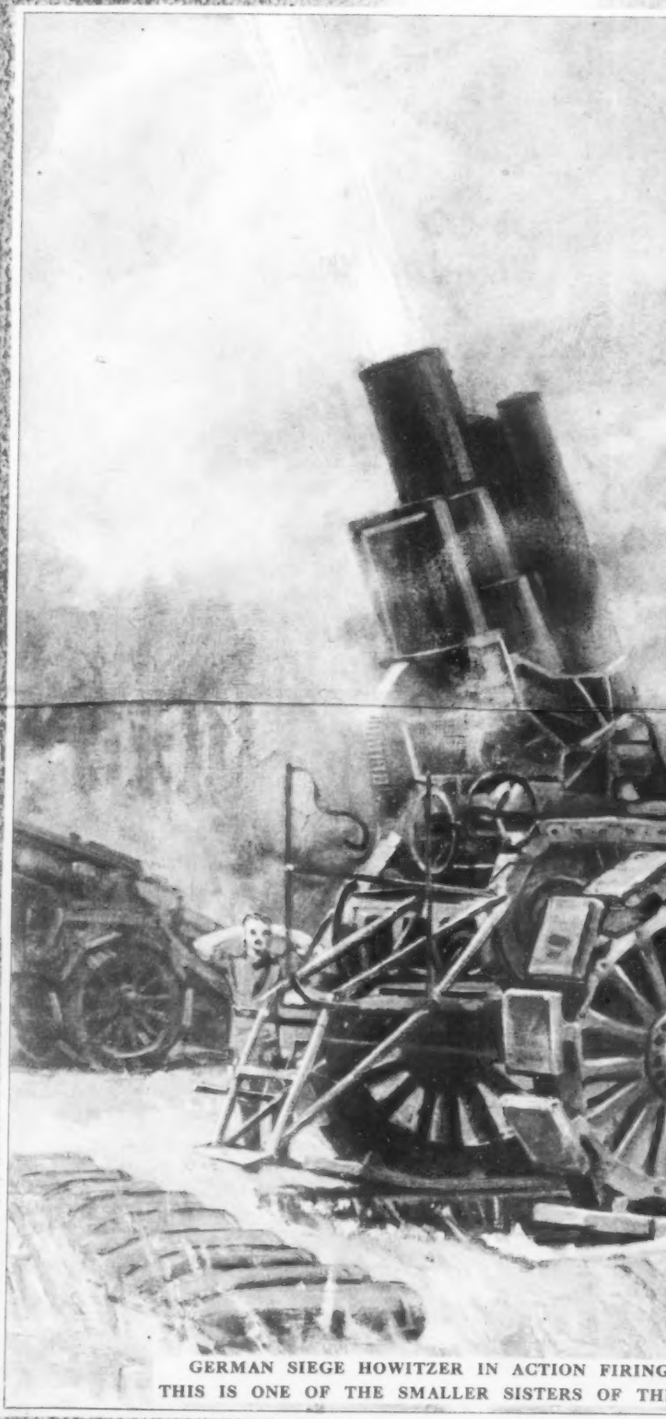
ONE OF THE ROTARY



RUSON ARMORED FORT.
ODERN SIEGE GUN TO BE OBSOLETE.
RNTABLE AND HEAVY MASONRY CONSTRUCTION.

A LIEGE BARBETTE THROWN FROM ITS FOUNDATIONS
BY GERMAN SIEGE GUNS.

ROTARY CUPOLAS OF MAUBEUGE.



GERMAN SIEGE HOWITZER IN ACTION FIRING
THIS IS ONE OF THE SMALLER SISTERS OF TH

N FIRING A 28-CENTIMETER SHELL.
OF THE GREAT 42-CENTIMETER GUN.

REFERENCE LIST OF PARTS OF

1 Periscope.
2 Surface signal halyard.
3 Surface running light.
4 Surface signal light.
5 Surface side light box.
6 Surface helm compass.
7 Surface navigator's compass.
8 Surface steering wheel.
9 Periscope support.
10 Life rail.
11 Central access hatch.
12 Dog for access hatch.
13 Water-tight vent covers.
14 Water-tight periscope stuffing box.
15 Fore stay.
16 Forward life line.
17 Under-water compass.
18 Periscope eye-piece.
19 Observation ports.
20 Depth meter.
21 Conning tower.
22 Engine-room speaking tube.
23 Torpedo and diving-station speaking tube.
24 Under-water steering wheel.
25 Periscope turning shaft.
26 Forward vent pipe.
27 Emergency tank blowout lever.
28 Battery acid neutralizing lever.
29 Depth gage.
30 Pressure gage.
31 Electric light.
32 Air pressure gage (after system).
33 Automatic sea opening tell tale and diving rudder lock.
34 Diving wheel.
35 Diving wheel gear box.
36 Vent pipe gate valve.
37 Periscope motor.
38 Battery acid neutralizing tank.
39 Air pressure gage (forward system).
40 Ventilating blower.
41 Torpedo intake runway.
42 Water-tight torpedo hatch.
43 Windlass motor.
44 Windlass.
45 Torpedo tube air valve.
46 Torpedo tube air tank.
47 Torpedo compensating tank.
48 Torpedo cap turning mechanism.
49 Torpedo cap.
50 Torpedo.
51 Torpedo launching tube.
52 Cable nipper.
53 Towing or mooring cable.
54 Anchor cable.
55 Anchor cable fair leader.
56 Hawse pipe.
57 Stem casting.
58 Collision girder.
59 Forward trimming tank.
60 Fuel tank.
61 Anchor housing tube.
62 Fuel tank.
63 Fuel tank swash plate.
64 Cement filling.
65 Collision bulkhead.
66 Mushroom anchor.
67 Water-tight collision casting.
68 Forward trimming tank suction pipe.
69 Submarine mine compartment.
70 Submarine mines.
71 Torpedo launching lever.
72 Submarine mine trolley.
73 Water-tight manhole cover.
74 Water-tight door to mine compartment.
75 Ladder grab rods.
76 Submarine mine discharge hatch.
77 Forward air flask compartment.
78 Compressed-air flask.
79 Battery testing set.
80 Portable wood shutters over batteries.
81 Forward battery set.
82 No. 1. Balancing tank (forward set).
83 No. 2. Balancing tank (forward set).
84 No. 3. Balancing tank (forward set).
85 Tank control manifold valve.
86 Fuel oil suction.
87 After balancing tank suction and supply.
88 Forward balancing tank suction and supply.
89 After balancing tank suction hand-operating stem.
90 Fuel oil tank suction hand-operating stem.
91 Forward balancing tank suction, hand-operating stem.
92 Main force and lift pump suction for after balancing tanks.
93 Main force and lift pump suction for fuel oil tanks.
94 Main force and lift pump suction for forward balancing tanks.
95 Main pump manifold.
96 Main pump cut out valve.
97 Conning tower access ladder.
98 Emergency ration locker.
99 Main pump suction and discharge pipe.
100 After battery set.
101 E
102 P
103 P
104 T
105 S
106 C
107 A
108. I
109 N
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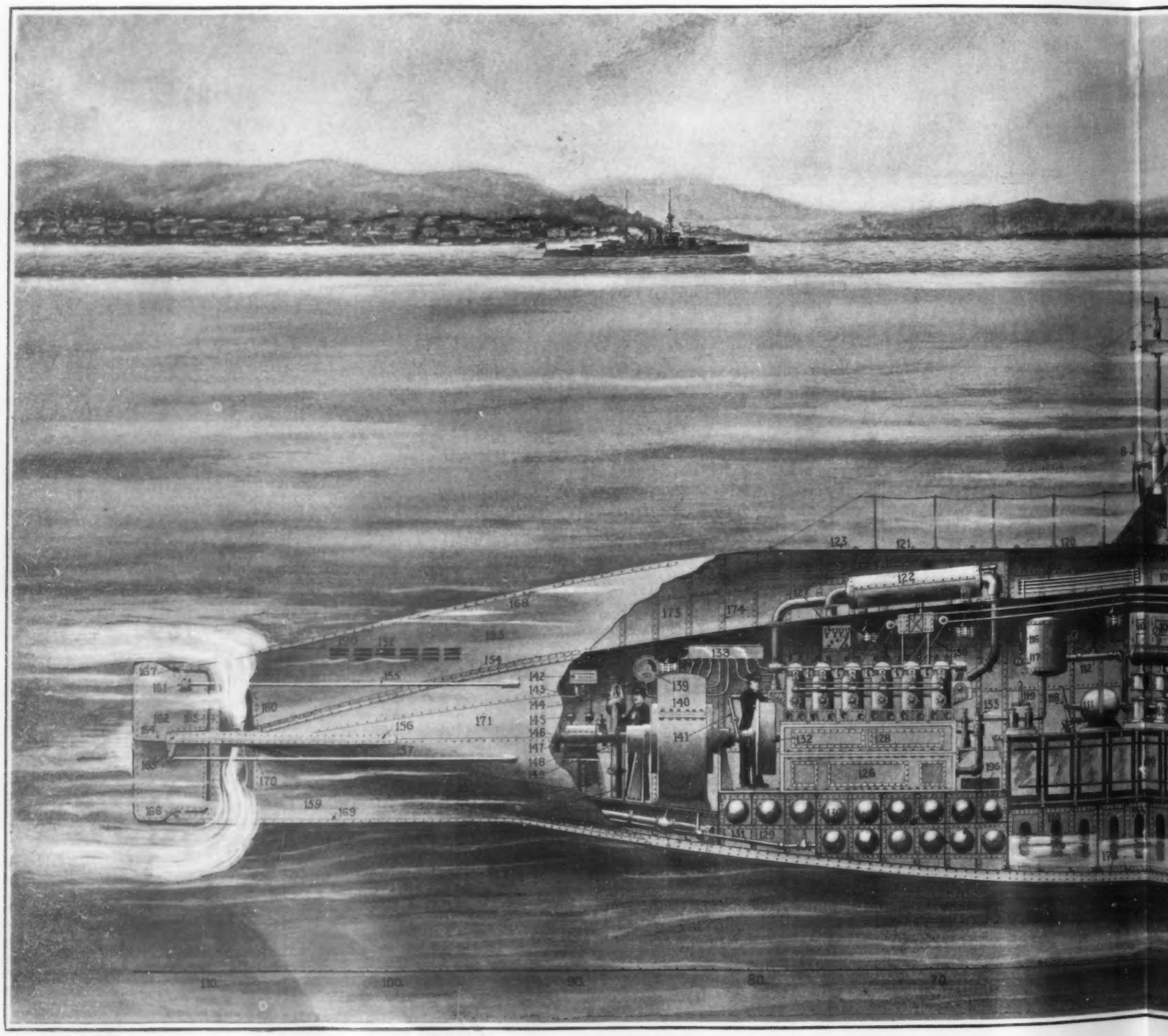

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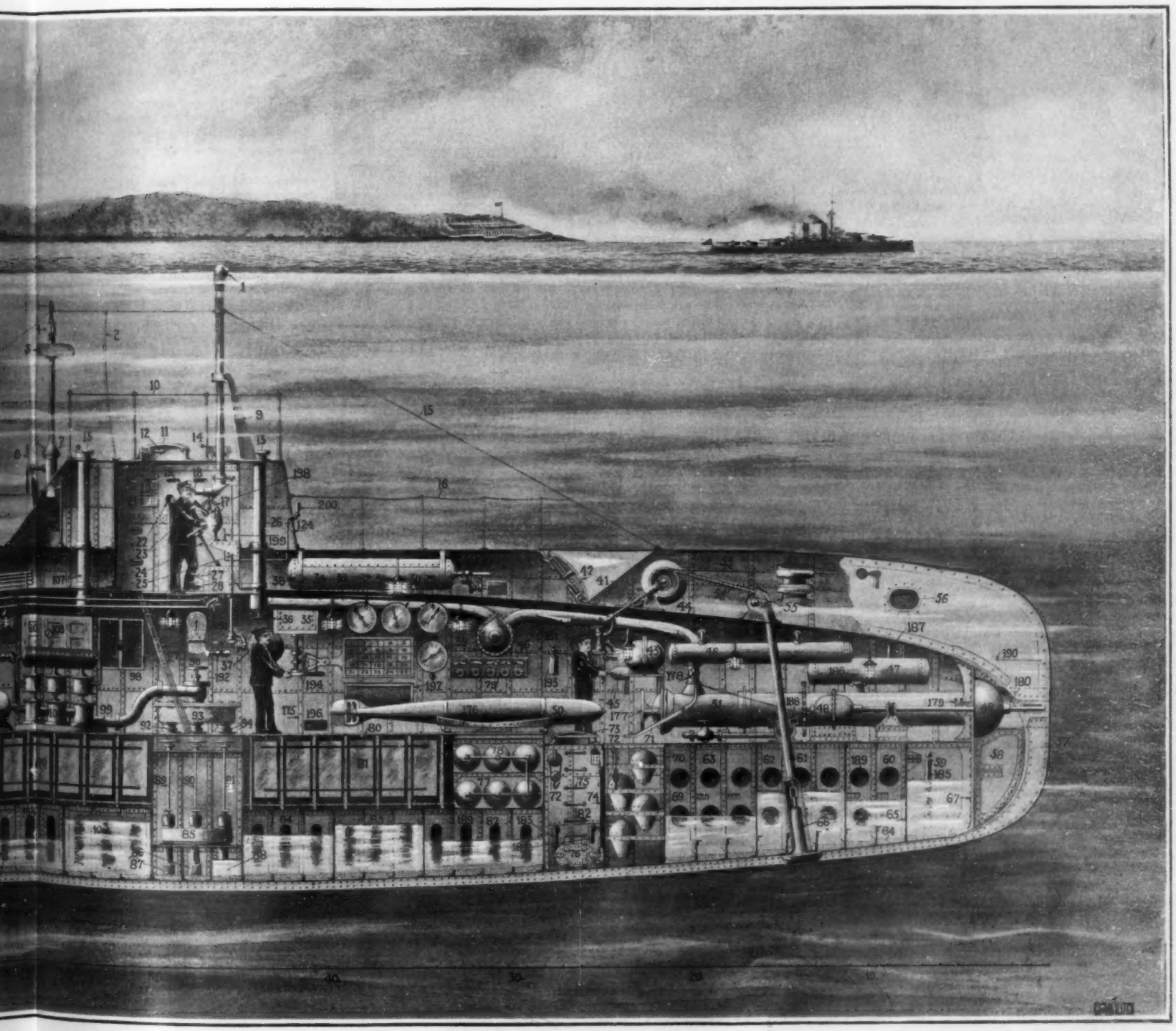
SECTIONAL VIEW OF A MODERN SUBMARINE, SHOWING DETAILS OF C

S OF SUBMARINE SHOWN BELOW

101 Electrically-driven air, fuel, and water pump.
102 Pump air compressing tank.
103 Pressure gage.
104 Tool locker.
105 Stem to steering engine.
106 Compass light.
107 After vent pipe.
108 No. 3. Balancing tank (after set).
109 No. 2. Balancing tank (after set).
110 No. 1. Balancing tank (after set).
111 Pump motor.
112 Suction pipe from vacuum tank.
113 Relief valve.
114 Vacuum gage.
115 Vacuum tank.
116 Lifting valve gage.
117 Load gage.
118 Main pump adjusting lever.
119 Hand pump.
120 Portable hatch plate to spare compartment.
121 Portable hatch plate to muffler compartment.
122 Muffler.
123 Water intake shutters.
124 Conning tower cutwater.
125 Steering engine.
126 Main engine oil flood case.
127 Steering engine controller.
128 Main engine.
129 After air flask compartment.
130 High pressure air flasks.
131 Air pipe to expander.
132 Flywheel clutch.
133 Engine air suction.
134 Strainer to after bilge suction system.
135 Bilge suction cut-out valve.
136 Conning tower control to main engine.
137 Conning tower control to main motor.
138 Automatic lubricator.
139 Conning tower engine-room indicator.
140 Main motor.
141 Clutch actuating lever.
142 Revolution indicator.
143 Revolution indicator shafting.
144 Main valve to sea opening.
145 Air pressure oil cups.
146 Main shaft coupling.
147 Main shaft thrust bearing.
148 Pinion for oil agitator.
149 Pinion for air cooler drive.
150 Thrust bearing foundation.
151 Intake pipe from sea opening.
152 Circulating water outlets.
153 Superstructure run.
154 Superstructure connecting angle.
155 Steering rudder operating rod.
156 Diving rudder strut.
157 Diving rudder operating rod.
158 Keel and fin connecting angle.
159 Fin keel.
160 Propeller.
161 Steering rudder lever.
162 Steering rudder.
163 Stern casting.
164 Diving rudder.
165 Diving rudder lever.
166 Fin keel rudder support.
167 Upper rudder bearing.
168 Non-watertight superstructure bounding angle.
169 Fin keel bounding angle.
170 Propeller fair water.
171 Twenty-five-pound shell plating.
172 Hollow water-tight suction keel.
173 Fifteen-pound superstructure plating.
174 Superstructure angle bars framing.
175 Circular hull framing.
176 Torpedo cradle.
177 Torpedo tube breech block.
178 Torpedo tube air cut-out valve.
179 Stuffing box for torpedo cap stem.
180 Outer torpedo discharge tube.
181 Fresh air ventilation terminals.
182 Divers' exit compartment.
183 Drain for diver's compartment.
184 Flood for diver's compartment.
185 Air blow-out pipe for forward trimming tank.
186 Water inlet for torpedo compensating tank.
187 Air blow-out for torpedo compensating tank.
188 Stuffing box for anchor tube.
189 Swash plate lightening holes.
190 Normal water line (above-water condition).
191 Fire hose.
192 Fire plug.
193 Extinguishers.
194 Diving rudder angle indicator.
195 Air cooling coils.
196 Electric heaters.
197 Lamp locker.
198 Engine telegraph.
199 Whistle pull.
200 Whistle.



S OF CONSTRUCTION AND METHODS OF OPERATING IT AND ITS TORPEDOES

Blowing Up Barbed Wire Entanglements

The Poles Bearing Explosives Used by the French, Russian and English Armies

SURMOUNTING BARBED WIRE WITH BAGS
TEARING DOWN BARBED WIRE WITH RAKE
SURMOUNTING BARBED WIRE WITH BAGS
POLE PRESCRIBED FOR BLOWING UP BARBED WIRE BY FRENCH REGULATIONS.
Bag containing Melinite
Fuse
Wheel to facilitate pushing of pole over ground under barbed wire
Pyroxylin Cartridges
Collar to receive forward end of second Pole.
Forward end of second Pole.
Bolt
Forward end of second pole.
Cross Strips
RUSSIAN MODIFICATION OF FRENCH POLE
Notch to receive forward end of second pole.
DESIGN OF POLE BY LIEUT. COL. KAZKEWITCH OF THE RUSSIAN ARMY
Sheet steel box to receive second pole
Fuse
Eye
Rubber Disc holding cartridges in place
Pyroxylin cartridges showing hole for passage of igniting flame.
ENGLISH SHEET STEEL TORPEDO TUBE
Forward end of second Pole.
Pin passed thro eyes to hold poles together
Sleeve which receives end of second Tube
Tube containing 23 Packages of explosive cartridges.
Forward end of second Tube.

A DEEP network of barbed wire is one of the most formidable obstacles with which a military position can be surrounded. Before the men behind it can be attacked in a bayonet charge it must be removed. Artillery fire is only partially effective. The most obvious way of forcing a way through a barbed wire entanglement is to cut it. In most armies a pair of nippers is considered almost as necessary a part of an infantry man's equipment as a rifle. Two rows of gloved men, fitted with nippers, can make a passage seven feet wide in ninety-five seconds—this during maneuvers. What the time would be in actual battle under fire it is hard to state. Would it be less when machine guns are pouring in several hundred shots a minute? Or will the tense excitement of the moment and the sense of danger slow up the wire cutters? One can only guess. Psychologically it is more reasonable to expect slow rather than fast work during an engagement. There is bound to be much fumbling.

Rakes, Ladders, Planks, and Bags Have Been Used.

But the nippers have seemed too slow even during maneuvers. Experiments have been made in removing whole sections of wire at once by means of a rake, to which a wire rope is fastened. This is thrown over an obstacle, and thirty men pull upon the rope. Thus a section eleven and one half feet wide and sixteen and one half feet deep is torn out. In order to reduce the time required to pass through a barbed trap (the glint of the wire is usually concealed by a bank of earth) some military engineers have thought that it is a waste of precious minutes to cut or tear it down, and that it is more rational to surmount the obstacle in some way. Structures of boards, ladders, and bags should be thrown over the wire, according to their ideas, and upon the platform thus made the men can press forward. Boards eight feet long, nine inches wide and three quarters of an inch thick, are fastened together by means of three cross pieces, leaving a clear space of three inches between the boards. The weight of the double board is thirty two pounds, and sixteen of them are employed, each carried by a single man. To place the sixteen double boards on the wire net requires about one hundred and forty seconds, as actual tests have shown, and it takes seventeen men sixty seconds to pass over the boards. As a time saving expedient, therefore, the method is hardly a success over that of wire-cutting.

Nor are ladders much better. In some experiments, conducted in England, ten ladders with nine rungs each were used. Each ladder, twelve feet long and twenty-two inches wide, weighed thirty-two pounds, and was carried by a single man. The ladders were laid down in one hundred and forty-five seconds, and sixty-five seconds were required by seventeen men to pick their way from rung to rung.

That this idea of surmounting an obstacle rather than cutting a way through it is not practicable, is better shown by the experiments which have been made with bags of cloth and wire. Twelve bags each eight feet long and four and one half feet wide (measured empty) and weighing forty pounds when filled with straw, were placed upon a net in ninety-five seconds, and seventeen men passed over them in forty-five seconds. When the bags are made of wire poorer results are obtained. Such bags are composed of two pieces of wire meshing, eight feet long and four and one half feet wide, laid on top of each other and placed together at the sides with wire. A quantity of straw three inches thick is pushed into the wire bag, which then weighs only twenty pounds. It takes ninety seconds to lay sixteen of these bags on a barbed wire entanglement, and it takes seventeen men sixty-five seconds to pass over them.

The French Pole System of Blowing Up Barbed Wire.

So important is this problem of coping with barbed wire that military engineers in Europe have given to it an immense amount of time and thought. Just before the war it was decided that the quickest way of disposing of barbed wire was to blow it up, and to achieve that end a system was devised by the French, which has been adopted in modified form by some of the great European powers. From articles that have appeared recently in the more authoritative military publications in the world, such as the *Revista di Artigliera e Genio*, the *Royal Engineers' Journal*, the *Revue du génie militaire* and the *Kriegstechnische Zeitschrift*, there is every reason to believe that the European armies now in the field are attacking barbed wire defenses in this new way.

The French instructions for the removal of barbed wire obstacles definitely call for the use of explosives. For this purpose long rods of melinite are fastened in bundles of three to a pole sixteen and one half feet long, three inches wide, and one and three quarter inches thick. At the end of the pole is a collar which projects forward eight inches, and into which the end of a second pole is fitted, if the extent of the explosion is to be more than the length of a single pole. Each pole has a wooden head of almost conical form, with a steel cap and two little wooden wheels five inches in diameter. The pole is pushed straight into the maze of barbed wire or along the ground beneath it. Thanks to its form and to the little wheels with which the head is provided, it glides in easily enough. If necessary, another pole is fitted into the collar of that already in the network of wire. The charge is ignited by means of a fuse connected with the last bundle of melinite in the pole. Each pole supports ninety-nine bundles or packages of explosive, equivalent to about six pounds of melinite per meter (3.28 feet), and is carried by two men. A single pole will blow open a passage about thirteen feet wide.

The Russian Pole is a Modification of the French.

Very much the same system is used by the Russian army. The explosive is carried on poles seven to ten feet long, which are thrown upon the obstacle. The measure of success obtained depends very largely on the manner in which the poles are cast, particularly if the netting of barbed wire is very broad. The last pole may be thrust into the netting, which procedure is not always successful because the tip of the pole may strike the ground. The width of the passage effected by the Russian method is not more than ten feet. In actual practice it has been found that parts of the obstacle are not destroyed.

Because of the defects of their own system the Russians are employing poles resembling those prescribed by the French army regulations. Pyroxyline cartridges are secured to wooden poles from one inch to one and one half inches thick, three inches wide and six feet long. The poles are shorter than the French, so that they may be more easily handled. In one of our illustrations the method of joining two poles is shown. At one end of each pole is a tapered bolt projecting outward about one and three quarter inches. The other end of the pole is recessed to receive the tapered bolt of the following pole. The pole, which is thrust forward first has a head, as shown in the illustration, which head facilitates movement and prevents damage to the explosive. At the sides of the head are two little wheels of not more than three inches diameter, which enable the pole to be pushed forward readily beneath the lowermost wires. The charge is placed in a cloth sheath and fastened to the pole. About three and one half kilogrammes of explosive (eight and

Blowing a passage through a barbed wire entanglement.

three quarters pounds) are distributed to the meter (3.28 feet). Capped cartridges are placed along the charge. The number of poles required for the opening of a breach depends on the width of the obstacle. If it is twenty-one feet wide three poles with eighteen feet of explosive will be sufficient. If it is twenty-eight feet wide, four poles with twenty-four and one half feet of explosive will be required. The total length of the explosive is from two to three feet shorter than the length of the barbed wire obstacle. One man can carry one pole. The poles are joined at the obstacle and pushed beneath it. This type of pole is very efficient.

Col. Kazkewitsch's Improvement.

The Russian pole is certainly more easily handled and carried than the French. But it has its objectionable features. The method of joining one pole to another by means of tapered bolts thickens the joint, so that it might be difficult to push joined poles forward. Capped cartridges must be used on the Russian pole, because the Russian explosive when strung out cannot be exploded with a single cartridge at the outer end of the pole. In the French system the explosive bodies touch each other at three points; in the Russian system at only one point.

It must not be supposed that the use of these French and Russian poles is not attended with mechanical difficulties, quite apart from the efforts which the defenders behind the barbed wire defense will make to frustrate the blowing away of their chief reliance. While the little wheels on the French and Russian poles facilitate the placing of the explosive within the netting itself, the poles cannot be easily pushed over ground in which holes have been dug or on which large stones have been placed for the very purpose of thwarting an attempt to blow a passageway in the wire. It may also happen that the barbs on the wire may cut the cord with which the explosive is fastened to the pole and thus scatter part of the explosive. The cloth sheath which the French use will not avoid this; for the cloth, too, may be torn by barbs and loose ends of wire.

To overcome these difficulties, Lieut.-Col. Kazkewitsch of the Russian army has designed still another type of pole. He abandons the two little wheels and in their stead fastens a rope to the end of the foremost pole. If a stone or a hole is encountered in pushing the pole forward, it can be lifted over the obstacle by means of this rope. The illustration explains the principle clearly. Another rope at the rear end of the last pole controls the lateral movement of the pole. Each pole consists of two wooden strips, *A* and *B*, held together by two perforated pieces of wood. The pyroxylin cartridges are held between these two strips *A* and *B* in such a manner that a long hole or conduit is formed through the entire charge. This hole serves the purpose of enabling the fuse to ignite in the whole charge. The cartridges are held in place by rubber disks, as shown. Each of these poles is four inches wide, five and one half inches deep, and about ten feet long. Two poles are joined in the manner shown in the illustrations, by means of a sheet steel box, to which a ring is fastened. By means of a pin the ring of one pole box can be secured to the double ring of another pole box.

This design has the merit of holding the charge in a very compact form, also the merit of flexibility when stones are to be avoided. But the projecting rings are likely to catch in wires and offset these advantages. All things considered, the French pole is much simpler.

The English Torpedo Pole.

Before the outbreak of war, the English army conducted some experiments at Bangalore, India, the object of attack being a wire netting sixteen and one half feet wide stretched on posts one half to three quarters of an inch thick and six feet to six and one half feet tall. The English engineers decided that the charge would have to be at least as long as the breach to be made and that the explosion should occur at about half the height of the netting, so that it would exert its force in all directions. In their opinion the charge should be contained in a perfectly smooth sheathing which could easily pass through the wire.

To meet these requirements, an instrument called a torpedo was designed, which consists of a sheet steel tube two and one half inches in diameter and six and one half feet long, filled with explosive. As the accompanying picture shows, one end is closed; the other end is open, but is provided with a sleeve which projects about eight inches and which is intended to receive the closed end of another tube if charges longer than six and one half feet are to be fired. The number of tubes which are thus joined depends on the width of the obstacle to be removed.

Each of these tubes is filled with twenty-three packages, of which each contains four explosive cartridges. Hence, a single charge of about five and one half pounds is good for a yard and one quarter. When several tubes are joined, the closed end of one touches the explosive of the preceding tube. Ignition takes place at the rear end of the last tube, and the explosion takes place through the entire mass without interference by the wall which separates the tubes. In order to facilitate transportation and ignition, each tube is provided with a point and a handle. The handle serves to close the open end of the tube during transportation, to prevent the explosive from dropping out and to receive the igniting device. It consists of a piece of pine wood one and one quarter inches long and is thick enough to fit snugly in the sleeve. At one end it has a hollow cylinder for a dynamite cartridge and cap. The fuse, which terminates at the cap, is threaded through a hole in the handle. A pin serves to connect sleeve and handle so that the handle may not drop out. The point, also of wood, is of conical form, and is held in place by a small iron sleeve of such diameter that it can receive the closed end of a tube. This point serves to open a path for the pole, no matter how dense or complex the wire netting may be. An empty tube with its point and handle weighs about eight and one half pounds. Loaded with dynamite, a tube weighs twenty pounds, so that it can easily be carried by a single man. If a torpedo longer than the six and one half feet is to be used, the first man pushes his tube into the barbed wire, point forward, and removes the handle. Then the second man removes the point of his tube and fits the end into the sleeve of the first tube and pushes the joined tubes forward. So tube is joined to tube. Only the first tube carries a point and only the last a handle. The results obtained with this system are said to have been exceedingly successful. Whether French, Russian, or English poles are used, the attacking force entrusted with the hazardous task of forcing a way through barbed wire must retire for a distance during the explosion. But how far? The French regulations state that the pioneers must retire one hundred and sixty feet in order that they may not be injured by their wire-destroying charges. The Bengalore experiments proved that the men may stand within three hundred feet of the explosion without danger.

Rushing through a breach made in a barbed wire entanglement by a blast.

Poles, to which packages or cartridges containing powerful explosive are attached, are pushed through the barbed wire entanglement. A time fuse is lit, and the men retire for the blast.

Atomic Weights of Lead

A PAPER was presented at the French Academy of Sciences relating to researches made by M. Maurice Curie, nephew of the late scientist, upon the different atomic weights of lead. The radio-active theories according to which certain bodies, such as radium, uranium or thorium, can evolve in course of time and become transformed to other elements (a striking verification being given by the transmutation of radium to helium), lead to placing the metal lead as the last term of the series of changes. This very common metal is thus derived from the rarest and most costly metal known. Another very curious idea is that if, instead of taking the radium-uranium family, we consider the thorium group, it is found that the last term of the evolution series is a body whose atomic weight is still very near that of lead. It was therefore of fundamental interest to verify these conclusions and see whether the metal lead which is found in uranium ores on the one hand, and the metal which is seen in thorium ores on the other, have or have not the same atomic weight as the lead extracted from galena. M. Curie made such researches, and found that ordinary lead from galena has atomic weight 207.01, while lead from uranium ores shows a clearly inferior value of 206.5. Metal from thorium ore gives a higher value of 207.1. The conclusions of theory are thus confirmed, and it is admitted that there are several varieties of lead having different atomic weights, according to the initial metal from which they were derived. A new field of research is thus opened, and perhaps other metals will be found to present distinct atomic weights according to their origin, showing that the phenomenon of transmutation is much more general than is supposed.

Cars in the German Armies.—It is estimated that there are at least 20,000 motor cars of the commercial variety now in use in the German armies, including tractors for heavy guns; and there are also 10,000 trailer cars. Besides these there are about 25,000 pleasure cars used by officers as scout cars and for transportation to various points at the front. A large additional number of pleasure cars have been taken by the government for temporary use in the interior of the country, with the intention of returning them to their owners on the termination of the war.

The War Game and How It is Played

Mimic Warfare for the Schooling of Army Officers

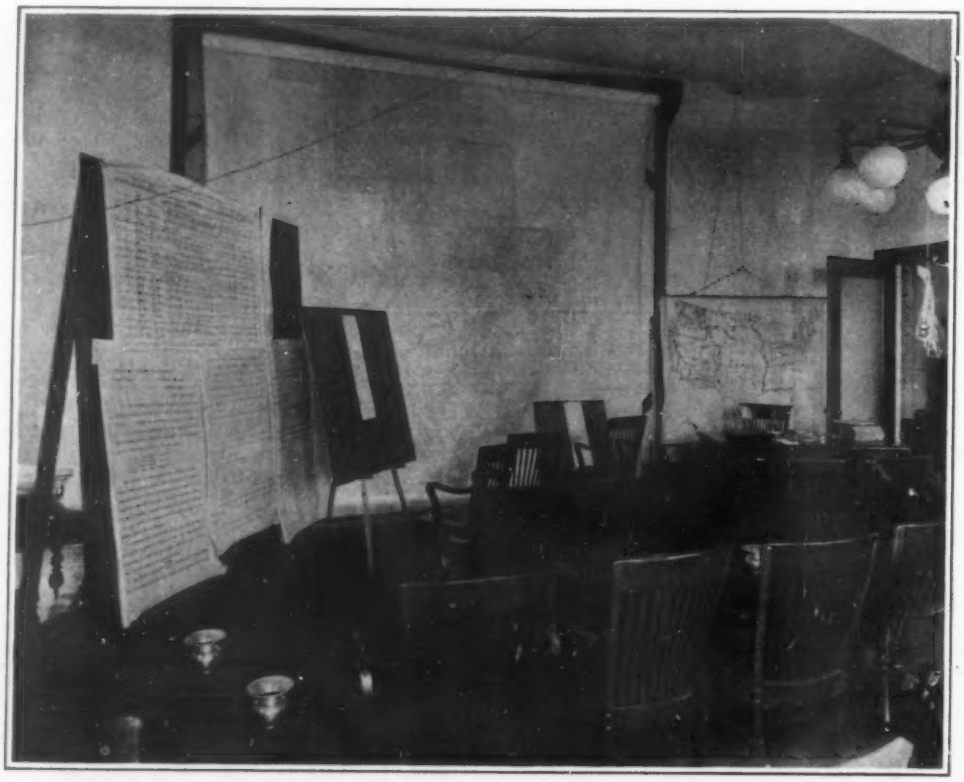
WITHIN the walls of the War College, in the city of Washington, are great libraries of military history and text books of war; steel cases, jealously guarded, containing the published maps of all the lands of the earth, pamphlet after pamphlet of information regarding the terrain and resources of the different countries, garnered no one knows exactly how, and a high ceilinged room which contains, among other simple furnishings, a huge, soft pine table.

The yellow surface of the table top is seldom seen, for there is usually a map upon it; a map whose limits reach to the very edges, pricked here and there by little pins with vari-colored heads; and also, there is usually a group of quiet, intent gentlemen, officers of the Army, leaning over the map, moving the pins here and there or shifting wooden or leaden blocks from place to place.

It is in this room that the war game reaches its climax, at least in the United States; for the officers studying the map so intently are members of the General Staff, and they *are not playing*.

The very title of the game is misleading. It is most decidedly not a game; on the other hand, it is one of the hardest, most painstaking studies imaginable, for it necessitates an already gained knowledge of a host of matters which can only be acquired by years of experience, a profound recollection of the history of battles and campaigns which furnish evidence of what certain conditions in war almost invariably produce, a knowledge of map-reading and topography which would equip any civil engineer or surveyor, experience with troops and marches, the effects of gun and rifle fire, logistics, mathematics, clear brains and foresight, resource, decision, and a number of other attributes too numerous to mention. And it is not played as a game, to see who will win, but to get results and experience, to profit by the very mistakes made.

"Kriegspiel" comes to us from Germany. In the time of Frederick the Great the game took on its first semblance of application to the study of the art of war, an outgrowth of the game of chess, the earliest war game. It was first taken up as a diversion and, although in a crude form, it achieved considerable attention. It is used now in the instruction of every army of the world.



Large-scale war maps and hypothetical orders in the Kriegspiel room of the Army War College, Washington, D. C.

The *raison d'etre* of the game is easily apparent. Modern wars are short and infrequent, and when they occur there is no time to gain experience before the armed clash comes. As much of this experience as possible must be had beforehand in a way which is the best substitute for actualities. A great deal of this experience may be gained by maneuvers, but maneuvers are too expensive to be indulged in on a large scale very often; besides, they must necessarily be held, for the benefit of varied ground, in different places each time, and of course, on private ground, leased for the exercises; but in time of peace a body of troops may not cut up a farmer's land with trenches and march roughshod across his fields of waving grain, burn his buildings, mine the highway and blow up the community's bridges. But you may do all this and more upon a large scale map, where everything, even an isolated sentry post, may be indicated by a pin or a block.

The great organization of the armies which are now clashing abroad is due to preparation, worked out by the war game. As an example of this preparedness, it is told of Von Moltke, who was reading a book when news of the declaration of war between France and Prussia in 1870 was brought him, that he only interrupted his reading long enough to say "Volume 3, on the second shelf; it is all ready"—and with only that opening of the throttle, the machinery of war began to grind, true to its thorough preparation. Kriegspiel, then, is war in miniature, the representation upon a map of the progress of a campaign or a battle. The scale of the map is usually six or twelve inches to the mile, for tactical exercises, and on a map of this size, every rise and swale, every house and bypath, every well, stream, and clump of trees may be plainly marked and read.

Every inch of the German Empire is plotted in this way, and the sections, about a foot and a half square, may be bought by anyone desiring to have them. In the United States, the vast labor of making the military map is going on daily, though the layman will scarcely know it, and in the course of time the location of every farmhouse in the country will be known. Possibly this military map is already completed—who knows?—and tucked away until needed.

The game is played by two men, or two bodies of men. The map to be used is placed upon the table and an hour or so before the exercise is to begin each commanding officer, designated, respectively, as the Red and the Blue commanders, is furnished with a typewritten paper containing a verbal outline of the situation and the conditions, as to the enemy and the object to be gained; also with small maps of the field, such as would be used in actual campaign. Having had a brief time to consider the situation, he calls his subordinate officers about him and issues his orders, written on the regular order blanks, as used in service. These subordinate officers are supposed to be in command of the units and execute the orders of their commander by indicating on the table map, with pins or blocks, the positions they are to occupy, according to the problem, at the outset.

When the Blue commander has made his dispositions he leaves the room, and his territory or dispositions are concealed and the Red commander enters, with his officers, and completes his preliminaries. Then he commences his advance. There are scales which show how far infantry, cavalry, and artillery will advance in a minute, scales which show how much road space a company, a regiment, a brigade and a division, with the attendant wagon trains, etc., will occupy. The time required for every movement must be figured out promptly and exactly. The commander scarcely ever sees the table map, but from his small one makes his deductions and issues his orders. Probably in a few minutes movements have been executed to represent what has occurred in an hour's time. His patrols have pushed out into the enemy's territory, actually placed on the large map by the umpires who supervise the game; his troops have advanced a certain distance, his infantry here, his artillery there, his cavalry scouting well out to the front. Then he leaves, with his staff, and the other commander takes his turn. The Blue commander is given a brief outline of what Red changes have become apparent to his advance guard and patrols since his last disposition and he makes his conclusions and issues the necessary orders accordingly, which are executed by his subordinates.

Then the Red commander takes his turn once more, and so they go, alternately, taking or attempting to take absolute cognizance of the new conditions which confront them and meeting them as best they may until the problem is fully developed and the object of the exercise is gained. Seldom is the problem continued to a conclusion of hostilities, for the object is not to see who wins, but to illustrate conditions. When the umpires and instructors are ready, the entire body of the participants assembles; the field, with its pins and blocks in their final positions, is uncovered, and a general discussion of the exercise is inaugurated, with criticisms and explanations by the instructors.

Let us take a small problem and follow it to a conclusion. A Red force has been severely worsted in combat, and is, of necessity, in full retreat, shattered in strength and rather demoralized by the defeat. This has all been set forth in the General Situation and Capt. Blank has been designated to command the Red rear guard, to cover the retreat of the broken force to which he belongs. His rear guard consists of two regiments of cavalry and a battery of field artillery.

The enemy is in eager pursuit, and unless he can be checked, will soon overtake, with his fresh reserves, the fleeing enemy. Fleeing is only a fancy word, for bodies of troops are seldom able to retreat at any great pace, and worn, dispirited men cannot move with the celerity of fresh troops, inspired to greater efforts by the flush of victory.

Capt. Blank knows, as an axiom, that time must be gained, that the enemy must be checked, to enable his harried main body to gain a little more distance; each ten minutes that he can delay the enemy means a precious half mile for his general. True, he may gallantly stand his ground and fight until his last man or last cartridge is expended, but when that is over and done, there will remain no rear guard to interpose its buffer. That will not do. He looks at his map, eagerly scanning the winding contours which mark the hills and valleys, and quickly settles upon a nearby wooded crest for his first stand. Then he issues his orders, writing them out for the umpires, although under service conditions they would probably be oral, with a decided snap to them. His time scale, cavalry-at-the-gallop, shows him that the position half a mile away may be reached in two minutes, and the yellow-headed pins gallop to the designated point, under the hand of the umpire.

Blank knows, from the General Situation, how close the pursuing troops were when he started, and his scale shows him how soon they will come up within range, hurrying along the road. At the proper time he opens fire and, naturally, the enemy is forced to halt and deploy, to drive him out with an attack by superior force. Witness how the time again enters into the problem! The pursuing force is twice as strong as his own, four regiments of cavalry. In column of fours, stretched out along the road, the four regiments cover almost three miles. Before the rear of the column can come up, to deploy in line, it must cover this three miles. Three miles times 4 minutes per mile equals 12 minutes gained for the retreating main body. All the time the deployment was in progress Capt. Blank's troopers, dismounted, and his artillery were pouring a fire into the enemy, delaying him even further. And about the time the enemy's deployment was completed, at

Blank's orders, written again, his battery limbered up and his troopers mounted, one regiment at a time, and galloped up the road, closing up on the main body, where they took up another position, and in a few minutes the regiment which had been left behind, to act for a moment as rear guard to the rear guard, came up and joined them. Blank has so far gained a mile and a half for his infantry.

The enemy, as soon as Blank withdrew, mounted up and commenced the pursuit again, this time striving to round the flank of the rear guard, taking advantage of all the natural cover possible to conceal his movements, and attempting to get to the retreating main body without encountering the rear guard.

But this is to be expected. Blank has foreseen this and has pushed his mounted patrols, at a stretching gallop, out in every direction, for a mile or more, and has left patrols at the first position to watch the enemy and give him prompt warning of his direction. A message comes saying that the enemy has swept around to the north. Another study of the map, lightning quick, shows where he may intercept the pursuers, and leaving a small force to cover the road, he rides away again to the flank, takes position, meets the enemy, forces him to deploy, and gains more time, hurrying away to a new position before the enemy can inflict any serious damage upon him.

After the exercise is suspended the umpire begins his comments. He will probably commend Blank's methods, but may recommend a closer study of the map, pointing out that Capt. Blank has taken his command up a precipitous bluff, a physically impossible feat, or has blandly forded a stream, impassable except for the bridges, a mile away. It is all in the game.

The most necessary qualifications for the players of the war game are: Understanding of the conditions and situations as presented; decision, quick and accurate, and the clear and proper drawing up of the necessary orders for the movements.

Understanding must naturally include map reading. There is nothing hard about it, but it is necessary that a conventional sign be recognized almost subconsciously, to assist in a visualization of the field, and this can only be acquired by practice, practice, practice.

For locating the positions of the various troops in the exercise and for placing them rapidly, a very ingenious system has been devised by our officers. For instance, when it is desired to show a long column on the march, the various elements of the command are represented by little oblong strips of cardboard, cut exactly to scale, a distinctive color or combination of colors for each branch of the service, pinned one behind another on a long strip of wood, which may be laid on the map intact, covering exactly the proper distance. When it becomes necessary to deploy, to form line to the front, the sections are taken from the strip, one by one, and pinned to the map in their order of reaching the line.

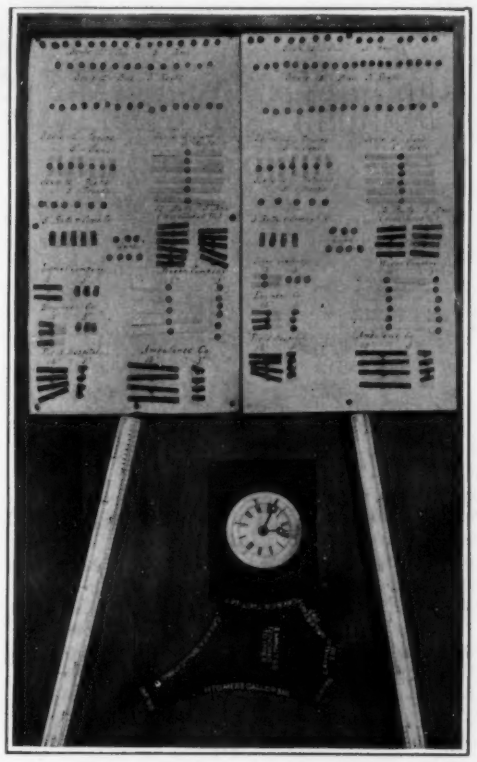
A deployed line, or line of skirmishers, is represented by small beads, strung on wires which may be bent in any shape to conform to the condition of the ground which they are supposed to occupy.

Individual pieces of artillery are indicated by single red-headed pins; a battery by a crimson strip of cardboard. A dummy clock with movable hands is used by each side, the hands being set to show the exact moment of a certain phase of the action. This is shown to the opposing commander, and from this indicated time he must compute the advance that has been made, by his tables, so much a minute for cavalry, artillery and infantry, according to the gait.

A scale, pasted upon flexible linen which may be bent to conform to the twisting of a road, is used to compute marching time and distances, and with other scales on irregular brass plates, time scales and sometimes dividers are the principal instruments of computation.

The days when a general, from a central point, could see his troops in action and direct their movements by word of mouth from a galloping aide, are past and gone. In the present day of successive thin lines of advance and attack, the line of battle which formerly may have been four or five miles long, is now stretched out to an attenuation of sometimes a hundred miles, and the commander-in-chief is perhaps twenty miles to the rear.

But to the house, or tent, which is his headquarters, there runs a network of slender copper wires, reaching to every point where his troops are in position, and a small corps of operators with head receivers clamped on are ever on the alert for the incoming stream of messages. And as fast as they are received, an aide, according to their purport, changes a colored pin a fraction of an inch on the map spread out before the Chief of Staff, and the map shows whether they, the body of troops in question, are intrenched on a hillside, in an orchard, or have forded a stream in the face of opposition.



Scales, dummy clock, and indicating devices used in the war game.

It is a great game, but it is not a pastime. To a layman, it might appear ridiculous to watch the seriousness and concentration of an earnest class of student officers, poring over a map and aimlessly moving little pins and blocks about its pictured surface. But in the hands of those men the safety of our country lies, and the state of our preparedness for war, with our tiny army. Our army now numbers thousands—these gentlemen play the map game with hundreds of thousands, what we would require in time of war, and they know that such a number is necessary—and strive their mightiest to learn how to hold the enemy in check with our little handful until the volunteers may be trained, which takes months! May the day of sacrifice be deferred!

The Kriegspiel table on which mimic battles are waged.

Where Waste Newspapers Go

WHAT becomes of the thousands upon thousands of newspapers that are discarded by readers on street cars, railroads, and in the homes? The question must naturally obtrude itself on the minds of many in the hurrying throngs to and from business, who note the disorderly litter that collects at terminal stations.

Waste newspapers are used almost exclusively in the manufacture of the cardboard or pasteboard which goes to form the paperboard box in which dressmakers, shoemakers, and department stores generally, deliver dresses, suits, shoes, etc., and one of the largest factories in the United States for the manufacture of this kind of cardboard is located just outside of Philadelphia on the Schuylkill River at Manayunk.

Long trains of freight cars may be seen at Manayunk, any day, loaded with bales of waste newspapers, the collection of many cities, which have been assembled here for conversion into the clean sheets of cardboard that will be used later for fashioning a box fit to hold my lady's gown of daintiest chiffon or tulle.

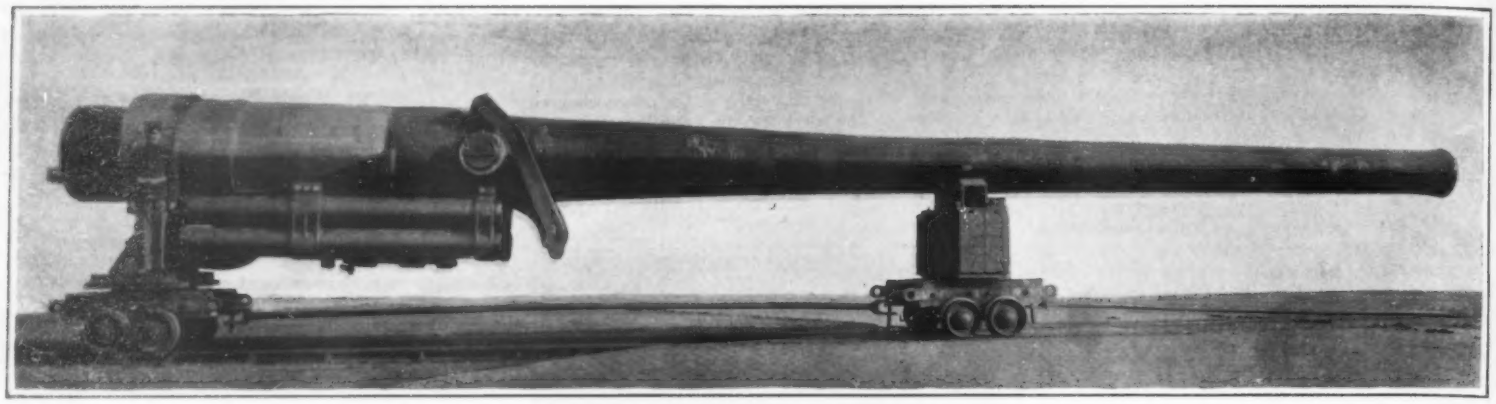
The preliminary operation of unpacking the bales of material which have been put together by waste paper dealers is not an agreeable operation to witness. As the mixed newspaper refuse is sold by weight, waste paper dealers are not overcareful in the sorting of the material, and tin cans and other heavy materials may be surreptitiously introduced at some stage of the process of packing the small bundles which are turned in by individual collectors of the material.

If one can stand the choking dust that arises as bales are opened and sorted by the busy workers in the paperboard factory, and he watches the operation of unpacking, he will note the truly miscellaneous character of the contents of these bales of "waste paper," which include newspapers of morning and afternoon editions with all their embellishments of scareheads in black and red, in company with a miscellaneous assortment of paper material like carnival streamers, harlequin caps, confetti, empty firecrackers, and all the other discarded paper waste of homes, stores, and streets.

After a rough preliminary sorting in which the heavier adulterants are removed, the mass of paper is ground to pulp in a special beating and washing engine. The mass is then led over strainers and the odds and ends of tin, bones, wooden toys, iron and woolen material that have escaped the attention of the first sorters are removed. A special furnace is maintained for the incineration of these foreign materials, the ash of which is utilized in other industries. It takes a lot of beating, pulping, and washing to transform the heterogeneous mass of mixed papers, which has the appearance of so much useless rubbish and waste, into the clean cardboard material into which it is ultimately fashioned.

The average suit or shoe box has a story of its own, and is not the simple, prosaic article it looks. If my lady who unpacks the container of dainty shoes, slippers or garments, as received from the store, could reconstruct the materials of which the box is composed, she would be more amazed than the subject of a fairy enchantment; for forests have gone to the making of the newspapers which form the substance of the box, the earth has given up clay to its fashioning, and interwoven with it are the streamers, firecracker cases and the various apparelings of many a carnival. Added to all this there might stand revealed many a thrilling story of life's comedy or tragedy as told in the day's news.

An Opening for American Teachers in Germany, due to the war, is pointed out by the American consul at Breslau. Heretofore nearly all the English-speaking teachers in German schools and universities, as well as English-speaking tutors and governesses in private families, have been Englishmen and English women. As such persons are now under a ban, there is a splendid opportunity for suitably qualified Americans to take their places.



The new 14-inch gun mounted on our latest dreadnoughts.

Rifles and Mortars

Construction and Operation of High-Velocity Direct-Fire Rifles and Low-Velocity High-Angle Fire Mortars

IF a 1,046-pound shell is fired at Sandy Hook from a 12-inch coast-defense rifle elevated to about eleven degrees, and charged with 280 pounds of powder, it will hit the side of a battleship distant 12,400 yards from the gun. If a shell weighing 825 pounds is fired from one of our 12-inch mortars, elevated to an angle of about 45 degrees, and charged with 58 pounds of powder, the shell will land upon the deck of the same battleship at the same range of 12,400 yards. Because of its high velocity, the trajectory, or line of flight, of the shell from the rifle will be very flat, and it will take only about twenty seconds to arrive at the target. Because of the high elevation of the mortar and its low initial velocity of 1,325 feet a second, its shell will describe a parabolic curve of great height, and it will be in the air for over a minute of time. Because of its relatively high initial velocity and the relative short time of flight, the 1,000-pound shell would reach the ship with a high remaining velocity and large penetrative energy; in fact, it would be capable at that range of penetrating a thickness of armor equal to the diameter of the shell, or say about twelve inches. The mortar shell, on the other hand, starting with a low velocity and subjected to the retarding effect of the atmosphere for over a minute of time, would reach the ship with a very low velocity, and therefore would be capable of only a limited amount of penetration; nevertheless, its energy would be sufficient to enable it to pass through the protective deck of a battleship and work havoc in its engine room or magazines.

The high-velocity, direct-fire rifle is sighted directly upon its object; that is to say, the gun pointer maintains the cross wires of the gun telescope directly upon the ship; in other words, he sees what he is firing at. The gunners who elevate and traverse the mortars of our coast fortifications, on the other hand, never see their target. They are entirely hidden from the direct vision of the enemy, and usually the mortars and the gun detachments are in deep pits sunk well below the level of the surrounding terrain. The data for the elevation and traversing (movement to right or left on a turntable) of the mortar are worked out by a group of officers who may be located in some protected position at a considerable distance from the gun.

Direct fire is used mainly for naval guns on board ship and for rifles in coast fortifications; but it is used only to a limited extent in artillery work on land. Except in those cases where the Germans, through their universal spy system, were thoroughly acquainted beforehand with the terrain, and were able to place their siege guns in locations, the exact distances of which from the forts to be attacked were accurately known, it is probable that the range was found by firing trial or "range shots" and correcting the errors by observation from some artificial or natural elevation, or from aeroplanes. In the defense of harbors by permanent coast fortifications, the distance to the enemy is determined by triangulation from concealed observation points, located at the ends of a lengthy base line, where instrumental observations determine the angles between the base line and the lines to the ship; or else the ship is located by depression finders, such as the Lewis depression finder used in our own coast fortifications, which automatically record the range when the telescope is focused upon the ship.

Direct-fire guns are used mainly for attacking the armored portions of ships or the parapets of fortifications, or bodies of troops in the field—for any form of attack, in fact, in which the gunner can sight directly on the target.

High-angle fire, on the contrary, is directed against the thinner horizontal armor employed on the roofs of turrets, or on the one or more protective decks of a warship. In field operations it is used against the roofs of armored cupolas and the vertical protection of whatever kind, which may be protecting the garrison. In field operations in the open, the 3-inch field pieces use direct fire where it is possible; but because of the concealment, natural and artificial, of the troops in modern fighting, a large part of this attack must be aimed through information given by observers in positions on eminences or in aeroplanes.

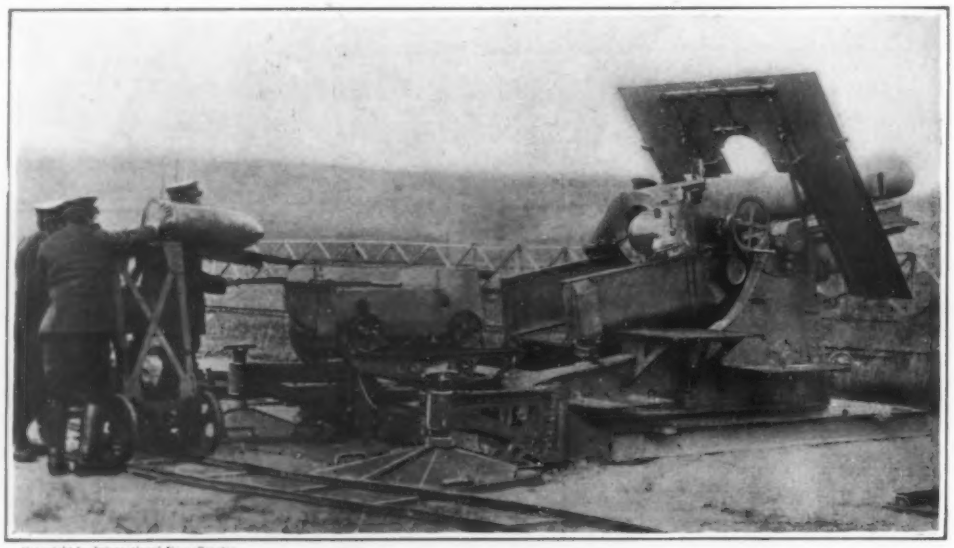
"Direct fire" is used with high-velocity guns elevated to not more than 15 degrees.

"Curved fire" is used with howitzers of low velocity, elevated to not less than 15 degrees.

"High-angle fire" is used with mortars of low velocity, elevated to not less than 45 degrees.

At the present writing it is established that the best armor-piercing shot fired from the most effective direct-fire gun is impotent on the present side armor at ranges consequent on angles of elevation about fifteen degrees. The velocity is so greatly reduced by the resistance of the air that the remaining momentum of the projectile merely serves to shatter it helplessly against the heavy side armor of the target. Direct fire has today a sure limitation of 15 degrees, and will have for some time to come. The limiting angle for indirect fire or mortar fire is likewise restricted, but from a very different cause.

At angles of elevation



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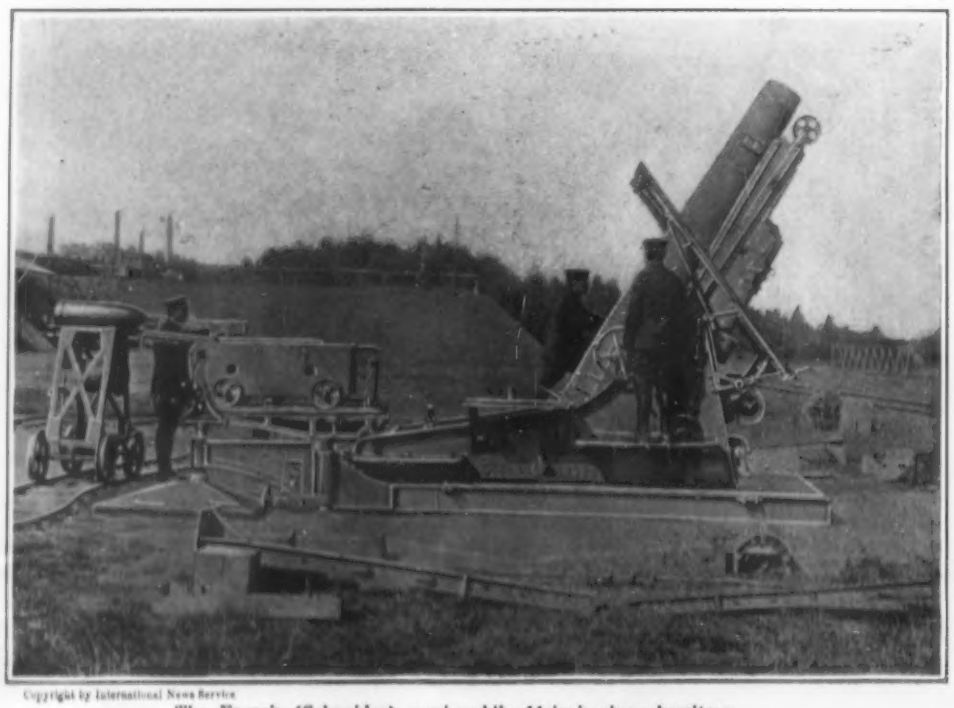
Loading the 11-inch siege howitzer.



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The French (Schneider) semi-mobile 11-inch siege howitzer.

above 65 degrees the time of flight becomes so great as to be prohibitive, and this marks the limit for the highest angle of mortar fire. There are other considerations involved in the strength of carriage and irregularities of flight above this angle, but these are subordinate to the unavoidable objection of excessive time of flight.

Of course, it is understood that to make a hit, it is essential that moving target and flying projectile arrive at the same spot at the same instant. In firing at a maneuvering battleship the element of time of flight thus becomes a most important factor, and it will be readily admitted that the time the projectile is in the air should not exceed one minute. By changing course and rate of speed, the commander of a maneuvering ship, in such a long interval of time as this, can readily place her at other than the predicted or anticipated point where she is expected to be when the shot strikes. This limit points, at the outer range, to an angle of projection not exceeding 65 degrees, since at this angle it takes the projectile over a minute to perform its path of flight.

It is a peculiar coincidence that with limiting restrictions so widely divergent, the scope of angles of projection is about the same. The total change in elevation for direct fire is limited to 15 degrees, and that for mortar fire to 20 degrees. These limitations of the upper angle thus prescribed place a great restriction on the attainable range. On this account it has been necessary to resort in mortar fire to what are called "zones." It is, of course, essential to cover every yard of range between the outermost and innermost limits of fire.

At a maximum velocity, within the power of the gun, behind a given projectile, the maximum range is attained at 45 degrees, but the minimum is not attained at 65 degrees. The only way to get less range after this angle is arrived at is either to reduce the powder charge or increase the weight of the projectile, or both.

Since the longest ranges are of little value, on account of the inherent inaccuracies, it was decided in Uncle Sam's service to build a mortar only strong enough to carry the heaviest projectiles to moderate ranges. A comparatively light projectile was designed for the outermost zone. With this projectile a certain portion of the total range is covered. The limits of this lighter projectile of 824 pounds weight are between a maximum of about 12,400 yards for 45 degrees, to a minimum of about 8,700 yards at 65 degrees elevation.

With our latest mortars, of greater length and using a sharper nosed projectile, an extreme range of 19,000 yards has been reached. These are being emplaced at Panama.

An approaching battleship is fired upon by mortars at the outermost range, and finally arrives at safe anchorage on account of the limiting angle of 65 degrees elevation, which results in the shortest possible range for the mortar under the restriction formerly adverted to. Alive to this situation, the mortar man employs a heavier projectile of 1,046 pounds weight, the same as that used in a 12-inch direct-fire gun; and so reduces his powder charge as to attain the same or but slightly greater range at his best angle of 45 degrees with this projectile than was previously attained at 65 degrees elevation with the lighter one. He thus establishes a second zone of fire that will last him till the enemy once more arrives at the angle of safe anchorage, as it may be called, of 65 degrees. Once again the powder charge is reduced so that the angle of 45 degrees will result in range but little greater than was previously attained at 65 degrees. So on, by successive reductions of charge, the range is shortened with successive zones of fire till the minimum limit is reached.

The limiting range is for an angle of 65 degrees with the smallest powder charge that will result in stability of flight. Stability of flight means that in spite of the low limit of velocity and the limiting twist of the rifling of the bore of the mortar, for high velocity, the gyroscopic action of the elongated projectile shall still be sufficient to keep it steady in flight. The wobbling of a spinning top that is dying out is an illustration of the effect that a too low velocity might have on a projectile fired from a gun. There is danger of the projectile "tumbling" end over end.

To give the mortar crew time to change the power charge from one zone to the next, a certain "overlap" of zones is provided. The next lower powder charge is so prescribed that at 45 degrees elevation the range will be somewhat greater than the charge next above at 65 degrees. To meet all these requirements, eight zones of fire are prescribed and the conditions met are herewith illustrated.

With such complications involved, and in consideration of the fact that the mortar crew is hid behind protecting parapets and does not even see the moving target attacked, results are marvelous. A mortar crew in recent firings obtained seven hits in eight shots at a range approximately 10,000 yards, or nearly six miles. That all difficulties have been met and overcome, in the construction of a range table and adequate method of correction for abnormal conditions of atmosphere, wind, and travel of the target, that will give a mortar crew a fair chance of a hit, is an achievement in which the servants of Uncle Sam, who are responsible for this accomplishment, find a solid degree of satisfaction. In no foreign country has so great a measure of success been attained by the methods of mortar fire.

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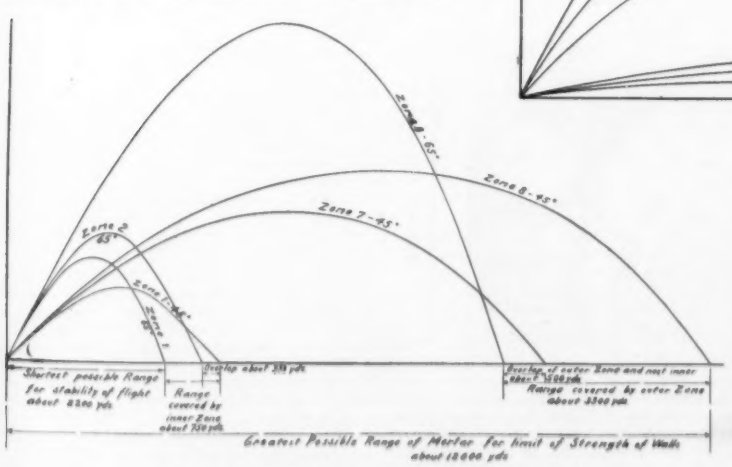
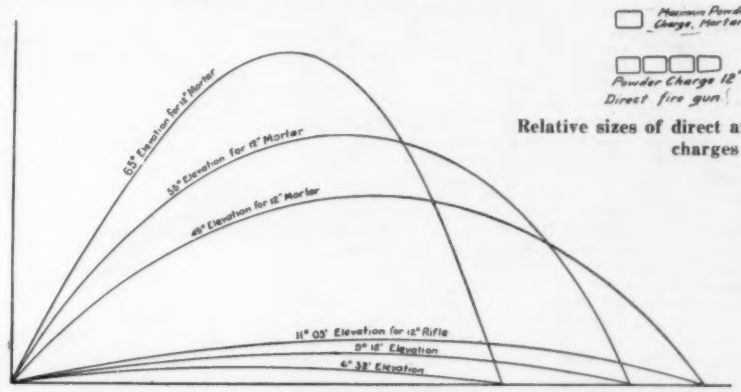
Note the siege railway at the rear for bringing up the ammunition.

A battery of French howitzers emplaced on concrete platforms in an open field near Verdun.


Zone 8 - 65°
Zone 7 - 45°
Zone 2 45°
Zone 1 45°
Zone 1 65°
Shortest possible Range for stability of flight about 8200 yds.
Range covered by inner Zone about 750 yds.
Overlap about 300 yds.
Overlap of outer Zone and next inner about 1000 yds.
Range covered by outer Zone about 3300 yds.
Greatest Possible Range of Mortar for limit of Strength of Walls about 12000 yds

Zones of fire of mortar batteries.

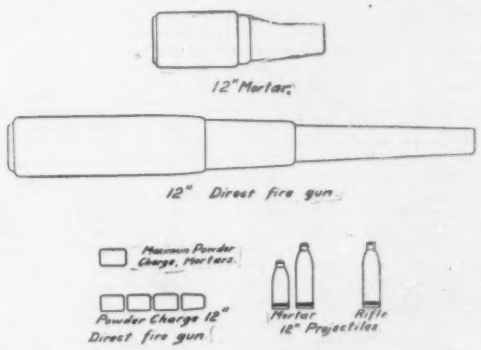

65° Elevation for 8" Mortar
58° Elevation for 8" Mortar
49° Elevation for 12" Mortar
11° 05' Elevation for 12" Rifle
9° 18' Elevation
6° 38' Elevation

Relative angles of elevation and trajectories of shells from 12-inch rifles and 12-inch mortars.

Package for Parcel Post.—A patent, No. 1,107,339, for the invention of Ira A. Milliron of New York city, has issued for a parcel post package in which the cushioning effect is secured with little weight by utilizing air cushions in the form of wrappers having a number of inflatable compartments and enclosed in a container.

Radium Water

WITH the discovery of the marvelous physical properties of radium, it seemed to be expected by the general public, somewhat irrationally, that its medical properties would be equally marvelous. The consequence has been that a number of hasty claims on behalf of the curative properties of radium have been made which have been subsequently abandoned, and there is now some danger that the public, finding itself repeatedly misled, will prove itself skeptical of results which have undoubtedly been achieved. But for some time work of a perfectly sane, sober, scientific nature has been carried out by the Radium Institute of London and its report, published in the *British Medical Journal*, contains results of a sufficiently startling, if not sensational, character. The apparatus employed in treating different diseases is of various types, consisting of flat varnished applicators, rectangular, square, and circular; the superficial area ranging from 0.7 square centimeter to 28 square centimeters. They are made in three strengths; full strength containing an amount of radium sulphate equivalent to 10 milligrammes of radium bromide to each square centimeter, and half-strength and quarter-strength. The smallest applicator contains 7 milligrammes and the largest 150 milligrammes. Capillary glass tubes filled with radium sulphate closely packed are used for insertion into openings in the body, in cases where the diseased area could not be reached in any other way; their length varies from 2 to 4 centimeters and their diameters from 0.2 to 0.3 centimeter. The radium emanation is sometimes collected in glass tubes or metal containers and used with appropriate screens, exactly as the radium salts are used, due regard being paid to the gradual fall in radio-activity resulting from the decay of the emanation. It is also dissolved in distilled water or a weak saline solution and administered by drinking or injection. The radium water is prepared by bubbling radium emanation through distilled water, which is then slowly drawn off into bottles. The bottles are sealed and carefully packed for delivery to all parts of the kingdom. The apparatus at the Institute is designed to give solutions with an activity from 1 to 2 millicuries per liter, an activity much greater than the best of the radioactive water from natural sources.



Relative sizes of direct and indirect-fire guns, powder charges and shells.

As a drink radium water would prove an expensive luxury, since a very moderate sized bottle costs two and a half dollars.

The present writer, on being asked to sample the radium water did so before learning its cost, and afterward estimated that he had drunk about a dollar's worth.

Radium water has the flat taste one associates with distilled water, together with a curious faint salty flavor, and its effect, so far as the writer's experience goes, is to render one extremely sleepy for the rest of the day.

For these reasons alone it is not probable that radium water will ever rival a John Collins or any similar preparation as a beverage, even for millionaires. Considered as a medicine one "dose" is of no use. It has to be taken continuously for some time, and the patient who starts taking radium water usually has to consume about one hundred dollars' worth before its beneficial effects are perceived.

RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

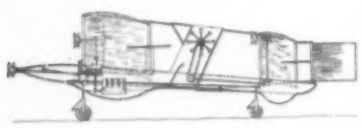
Pertaining to Apparel.

FOOT REST.—G. L. TUPTS, Anahuac, Texas. This rest is especially adapted for supporting the foot during shoe polishing, and suitable for use in shops or in other places, wherein a support is provided, having means for clamping the shoe to the support, and a stand with which the support is so connected that it may be adjusted to the proper height for engagement of the shoe by the grips.

SHOE LACE TIP.—C. R. JEFFORDS, 19 Union Park Ave., Jamaica, New York, N. Y. This invention provides a tip for shoe and other lacings which is more firmly attached to the lacings than other tips of the same class, and which has the additional function of serving as a fastening or attaching device for the free end of the lacing.

Pertaining to Aviation.

AEROPLANE.—V. N. ROSATO, 166 Nepperhan Ave., Yonkers, N. Y. The inventor provides an aeroplane body having longitudinally arranged passageways for air, and such passageways are controlled by certain pivoted doors or shutters for the purpose of increasing



AEROPLANE.

the safety of the device in case of accident. He also provides an upwardly inclined passageway through the aeroplane body and mounts therein a wheel having geared connections with an auxiliary propeller for the purpose of steadying the machine in ordinary flight.

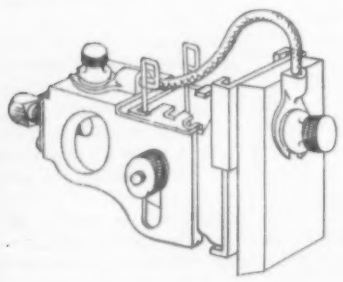
SAFETY AEROPLANE.—T. S. HAYNES, care of Seim and Austin, Bay City, Tex. The invention provides a means whereby the aviator may detach himself from the main or heavier portion of the construction and be sent to the earth in safety while seated on the usual seat of the machine and supported for gradual descent by means of the upper of the two plane may be utilized, to effect the desired the nature of a parachute.

CURVING RIB FOR THE SUPPORTING SURFACES OF AEROPLANES.—P. C. ELLIOTT, P. O. Box 145, Lawrence, Kan. This invention relates particularly to the supporting ribs of that type which may be curved, or the curve eliminated at the will of the operator, the object being to provide ribs of a certain structure whereby the supporting beams of the plane may be utilized, to effect the desired curvature of the rib, by rotating the said supporting beams.

Electrical Devices.

STARTING BOX.—M. TAIGMAN, 241 Wooster St., New York, N. Y. This improvement provides a box wherein all electrical connections are protectively covered; provides a resistance unit operably constructed independent of the containing box thereof; and provides a terminal panel arranged to receive the electrical supply circular leads.

BRUSH HOLDER.—A. N. SAMMARONE, 18 Cuyahoga St., Akron, Ohio. The invention has for its object to provide a device especially adapted for holding commutator brushes of electrical apparatus, wherein a holder is provided formed from two pieces of stamped



BRUSH HOLDER.

metal, folded or bent in such manner as to provide a substantially box-shaped holder having ways or guides to support the ordinary carbon brush for adjustment, and wherein resilient means is also provided, adapted to engage the brush to press it toward the face of the commutator.

ELECTRIC CLOCK.—L. CERF, 49 Maiden Lane, New York, N. Y. In order to insure great accuracy and to require a minimum amount of electric current for actuating the clock, use is made of an auxiliary spring driving device placed under tension by the action of the solenoid and adapted to drive the train of gear wheels of the time mechanism during the time the core of the solenoid returns to normal position.

SYSTEM OF ELECTRICAL SUPPLY.—A. H. HEYROTH, Hawarden, Mont. This invention relates generally to systems of electrical supply, and more particularly to means for placing a generator into or out of co-operative relation with the storage battery, the condition determining the operation of the said terms being the E. M. F. of the generator.

WINDMILL POWER PLANT.—A. H. HEYROTH, Hawarden, Mont. This invention relates generally to windmill power plants, and is particularly directed to methods of control in the event that the wind varies its velocity or rises to such a velocity that the voltage generated becomes excessive.

METHOD OF OPERATING ELECTROMAGNETIC STRIKING TOOLS BY MEANS OF ALTERNATING CURRENT.—L. SCHÜLER, Berlin-Lichterfelde-West, Germany. This invention relates to a new method of operating electromagnetic striking tools by means of alternating current with the aid of synchronous interrupters, whereby a satisfactory working of the striking tool is obtained, while all sparks during the interruption of the current are avoided.

Of Interest to Farmers.

BEET HARVESTER.—H. B. SCHRADER, Sterling, Colo. This invention has reference more particularly to a harvester provided with a beet-top cutting mechanism. The purpose of the improvement is to provide a simple and inexpensive beet harvester, strong in construction and having an adjustable top-cutting mechanism.

HAY RACK.—E. H. GAGNON, 116 House Bldg., Pittsburgh, Pa. An object here is to provide an improved structure which may be readily placed in position upon the wagon and readily and easily removed. Another object is to provide a structure which is comparatively light but strong, and adapted to receive loads of different material in addition to hay.

SANITARY MILK PROTECTOR.—C. E. NARY, Georgetown, Ind. The invention provides a device for connection with a cow, and so arranged that it may be supported inclosing the udder of the cow, in such manner as to protect the udder from contact with foreign matters, and wherein mechanism is provided for supporting the device.

ROTARY STUMP EXTRACTOR AND LIFT.—A. L. MOORE, care of Pan-American Land and Lumber Co., P. O. Box 910, New Orleans, La. The purpose here is to provide an improved machine whereby to sever the roots of a stump and extract the stump in a manner to produce a minimum disturbance of the ground, so that the ground is left substantially intact for cultivation.

BOOT FASTENER FOR DRILLS.—T. C. GARRITY, Lincoln, Kan. This invention relates to grain drills generally, and more particularly to a scraper attachment for disk furrow openers. It provides a novel means for arranging and attaching a scraper to the disk, whereby the scraper may be adjusted to work against the disk, and to take up wear as the scraper or disk becomes worn.

SILAGE HANDLING APPARATUS.—J. L. BEANE, Legrand, Iowa. This apparatus is capable of installation in connection with any silo, wherein a carrier is arranged to travel from the silo to the place of disposal, and wherein the carrier is arranged in such manner that the load may be dumped whenever desired, and wherein tripping mechanism is provided for operating the dumping mechanism of the carrier, the said mechanism being so arranged that it may be operated to dump the carrier at any point.

CHECK ROWER STAKE.—D. M. LUSE, Rockwell City, Iowa. The invention is an improvement in check-rower stakes, and has for its object to provide a stake of the character

CHECK ROWER STAKE.

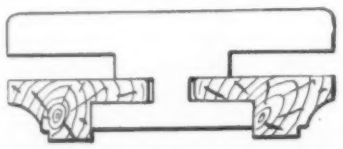
specified, for supporting the end of the check wire, and wherein means is provided for engagement by the check wire, and other means for supporting the said engaging means for movement laterally with respect to the wire.

CLAMP.—A. J. BANKS, Montour, Iowa. The invention refers to wire fence construction, where the wire mesh is tightly stretched between fence posts and secured thereto, this requiring that means for quick and easy engagement with said mesh must be provided and which means are connected with the stretching tackle or apparatus, and it was in order to effect such engagement and disengagement in an expeditious and easy manner that the invention was conceived, this constituting the main object of the invention.

Of General Interest.

GEODETICAL UNIVERSAL INSTRUMENT.—H. R. VON WINTERHALDER, Klosterneuburg, near Vienna, Austria-Hungary. The telescope carrier is constructed as a diopter, that is to say, it comprises two sights connected by a rule detached from the other parts of the instrument. Therefore the instrument can be used for measuring horizontal and vertical angles, as well as for determining slopes and distances, and also for work on the surveyor's table.

MOLDING.—W. R. FRIEDEL, 718 South Dudley St., Memphis, Tenn. In this patent the invention relates to improvements in molding, and has for an object to provide an improved structure for receiving wall boards or materials of similar nature. Another object in view is to provide a molding which will receive



MOLDING.

wall boards or paneling and allow for ample expansion while clamping the boards firmly in place. The molding may be made in slightly different ways so as to accommodate different places in the building, as, for instance, the ordinary side wall or ceiling and the corner.

EXHIBITING DEVICE.—R. P. JARVIS, care of Aloytious F. Lutz, care of New York Stove Mercantile Co., Beloit, Kan. This device comprises a sign board or plate having a row of illuminating devices along its top and bottom, and bearing on its front face the things to be exhibited. These things may of course be letters or pictures, or any form of representation which is useful for the advertiser's purpose.

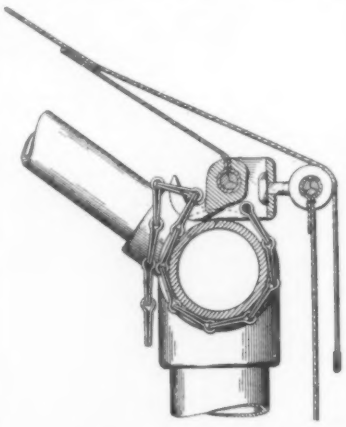
SIDEWALK AIR AND LIGHT GRATING.—E. BERSON, 1113 Van Alst Ave., Astoria, New York, N. Y. The general objects of the invention are to improve and simplify the construction of gratings so as to be reliable and efficient in use, extremely simple and durable. The invention relates to gratings especially for use in sidewalks for permitting light and air to pass into basements and cellars.

NON-REFILLABLE BOTTLE.—B. F. KLASS, care of J. P. Ryan, 158 E. 36th St., New York, N. Y. This bottle or vessel, after its contents have been dispensed, cannot be refilled without destroying the bottle, thus serving as an effective means for preventing the sale of liquids or the like unscrupulously.

SPOOL.—J. C. HOFFMAN, 10 Jones St., Bronx, New York, N. Y. The invention relates to spools, and has reference more particularly to spools made of pasteboard; and the object thereof is to provide a simple, strong, and inexpensive spool in which the flanges and the central tubular portion of the spool are rigidly connected.

DUPLEX ENVELOP.—A. MILLER, Albemarle, N. C. Mr. Miller's invention is an improvement in the small duplex or "twin" envelops designed particularly for use in churches to receive offerings for different purposes. The feature of the novelty is the construction of the middle or connecting portion of the twin envelops.

FASTENING.—A. F. NUGENT, 231 W. 21st St., New York, N. Y. This fastening is for use on house and sidewalk awnings, canopies, tents, vehicle covers, curtains and similar devices, for convenient attachment to the fabric covering and for securely holding the same in place on its framework or other support and



FABRIC COVERING FASTENER.

without the use of staples, rings, grommets, hooks, straps and buckles, snap hooks, lacings, tying bands and the like, thus allowing the workmen to securely fasten the fabric coverings in place, especially in extremely cold weather.

KODAK SUPPORT.—L. F. SMITH, 2543 Decatur Ave., Bronx, New York, N. Y. This improvement has reference to photography and has particular reference to kodak appliances. Among the objects of the invention is the provision of a simple, reliable, and satisfactory means for connecting a vest pocket kodak to a tripod for the usual purposes.

COLLAPSIBLE SHIPPING CRATE.—G. MORGAN, 225 Riverside Drive, Binghamton, N. Y. This invention is designed more especially for use in shipping bread, although it is adapted for other purposes where commodities are to be shipped from manufacturers or shippers to the market and the crates returned empty to the manufacturers or shipped for repeated use.

DETACHABLE CONNECTION FOR BUILDING BLOCKS.—D. M. WARD, Gary, Ill. The invention relates to improvements in detachable connections, and in particular has for an object to provide an improved building block structure wherein the various blocks may be connected up quickly and easily and in such a manner as to retain their built-up position.

WATERPROOF CONCRETE BUILDING BLOCK.—A. D. WILTSE, 265 Cumberland St., Brooklyn, N. Y. This invention improves the construction of building blocks in such a manner as to make them both strong and light with respect to mass. It provides a concrete building unit having associated therewith, as a permanent part thereof, a reinforcing stiffening rib of wood or material of any character adapted to be used as a means to support or connect laths or other building material.

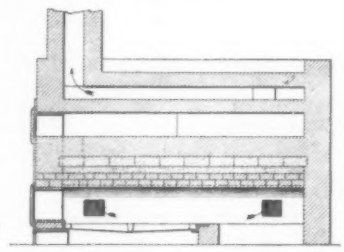
NON SPILLABLE SHIP TABLE.—P. W. KEYMER, 610 Bergen St., Brooklyn, N. Y., and G. I. BROWN, Florida, N. Y. In the present patent the inventor provides a table for ships formed with a top arranged on movable supports, which in turn are controlled by weights, whereby as the ship tosses the weights will be actuated for maintaining the top of the table in a horizontal or substantially horizontal position.

WATER SYSTEM.—T. C. WILKES and S. E. PHILLIPS. Address the former, Box 295, Jackson, Mich. The object of this improvement is to provide a system so arranged that water may be drawn from the main at all times regardless of temperature conditions, and regardless of whether or not the usual conduit pipe is frozen.

COMBINED BLOTTER HOLDER AND HAND REST.—A. E. HUBBELL, Bay City, Mich. The invention is a hand-rest provided with means for holding an ordinary blotter and particularly adapted for use of bookkeepers, but also serviceable for general use of writers. The ruler possesses the desired flexibility to permit its bending in its use for blotting purposes.

TREATMENT FOR OILS, FATS, AND THE LIKE.—N. TESTRUP, 6 Broad Street Place, London, E.C., England. The objects here are to improve the quality and to alter, as may be desired, the properties of oils, fats, and the like, including unsaturated fatty acids and their glycerids, e. g., such as used in soap and candle industries, more particularly by hardening the same, i. e., by altering their melting point and by deodorizing and bleaching the same.

OVEN.—C. C. LEIDY, 863 Prairie St., Jacksonville, Ill. In the present patent the object of the invention is the provision of an inexpensive, simple, and efficient oven in which the



OVEN.

contraction and expansion of the oven body structure is balanced by a granulated non-conducting material placed within the body structure of the oven.

ANIMAL TRAP.—J. E. RUBY, 442 Highland Ave., Indianapolis, Ind. The invention has reference to animal traps of a kind suitable for killing rats and mice. More particularly the improvement comprehends a trap of this kind, in which the trigger is rendered especially sensitive for enabling animals to actuate the trigger.

INDESTRUCTIBLE AND COLLAPSIBLE DRINKING CUP.—P. F. JACKSON, 170 Boyd St., Stapleton, N. Y., N. Y. The object of the invention is comprehended in providing a cup to be pressed or molded of rubber or other resilient material or composition, to lie flat and thereby be rendered especially adaptable to be carried in one's pocket, and also reinforced at its edges to assist in its assumption of a flat position as well as to provide for increasing wearing qualities.

COMPOSITION OF MATTER.—C. HEINRICH, care of Fluoride Mfg. Co., Farmingdale, N. Y. The ingredients of this matter are thoroughly mingled and mixed together while in a dry state, to form an impalpable powder which can be readily put up in cans or bags so as to be ready for use whenever desired, the composition keeping unaltered for any reasonable length of time.

DIAPHRAGM FOR SOUND REPRODUCERS.—F. W. THOMAS, New City, N. Y. This inventor provides a diaphragm for sound reproducers such as are used in gramophones, graphophones, receivers and transmitters of telephones and other sound-reproducing instruments and machines which is exceedingly sensi-

tive for the reproduction of sound vibrations. Mr. Thomas has invented another diaphragm for sound reproducers which overcomes certain objections by producing a metallic diaphragm which in recording and reproducing qualities is superior to mica, far less expensive, smaller in size for the same capacity of sound reproducing and recording, and which is practically indestructible, whereas mica diaphragms are of very short life because of their laminated structure.

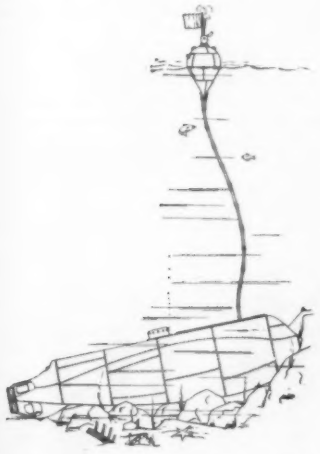
STEREOPTICON SLIDE CARRIER.—F. A. APFELBAUM, 1560 Broadway, N. Y., N. Y. The invention provides a slide having a movable member for use in conjunction with means provided in the carrier for moving said member; provides a carrier having a plurality of pockets for holding slides, and operative means in each of said pockets for operating said movable members; and provides a carrier having operating means of the nature mentioned, furnished with manually operable means for actuating the same.

CHLOROFORMER.—J. S. OLIVA, Maximo Gomez No. 1 Regla-Habana, Cuba. The object in this case is to provide a device which is sanitary, as it can be easily taken apart and sterilized, which can be quickly and easily attached and removed from the patient, in which

CHLOROFORMER.

the amount of anesthetic administered can be easily regulated, and in which the anesthetic before being administered to the patient is spread over a large area to facilitate the evaporation of the same.

SIGNAL FOR SUBMARINE VESSELS.—F. A. LOVEGROVE, 8 Campbell Road, Halifax, Nova Scotia, Canada. This invention provides a floating device equipped with a signal or sig-



SIGNAL FOR SUBMARINE VESSELS.

nals operable from a station within a submerged vessel; provides means for liberating at will said device; provides a variety of signals carried by said device and operable from within the hull of the submerged vessel; provides suitable devices for establishing communication with the inmates of the submerged vessel; provides means for supplying a submerged vessel with atmospheric air; and provides means for elevating a submerged vessel or for assisting in the elevation thereof.

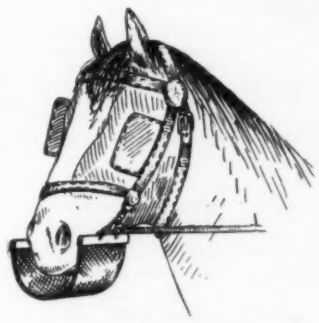
SMOKE AND FUME FILTER.—E. H. GAGNON, 116 House Bldg., Pittsburgh, Pa. This invention has reference to improvements in devices for cleaning and removing various substances from smoke fumes and the like, and particularly to devices for filtering and cleaning the smoke and fumes from smelters and other similar devices.

BUOY.—E. W. SKOLDBERG, 526 17th St., Brooklyn, N. Y. The buoys in use at present for mooring purposes have several objectionable features. To obviate these, Mr. Skoldberg provides a buoy which is practically unsinkable and unaffected by the rough usage to which it is subjected, and which is adapted to give within certain limits and relieve the strain on the mooring chain due to jerking caused by wave motions.

DENTAL HANDPIECE.—A. CAMPBELL, care Spokane Dental Supply Company, Chemical Building, Spokane, Wash. Mr. Campbell has invented an improved dental handpiece adapted for use in holding dental tools. The construction of the device is such that it may be adjusted quickly for gripping or releasing the shanks of burrs or other tools. The improved handpiece is made up of comparatively few parts and comprises a pair of spring jaws which may be readily opened or closed by turning a knurled nut.

ADJUSTABLE HAND STAMP.—W. DOWLING, 3605 Grand Central Station, New York, N. Y. The invention provides a hand stamp with an adjustable frame for supporting a plurality of removable or interchangeable stamp elements whereby the device may be lengthened or shortened according to the length of the word, name, or legend to be stamped or printed.

HORSE PROTECTOR.—J. W. NILSSON, Balfour, N. D. This invention provides a device for effectually protecting a horse's mouth from attacks by bot-flies, at the same time allowing normal breathing of the animal. It also



HORSE PROTECTOR.

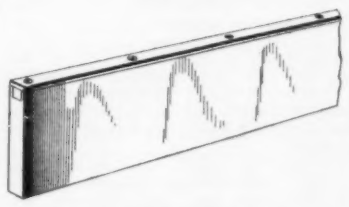
provides for a protector so constructed and arranged that when in place on an animal, the latter may eat or drink without the necessity of removing the protector.

Hardware and Tools.

LOCK FOR HAND BAGS.—J. PARTMANN, 778 Prospect Ave., Bronx, N. Y. A stud is mounted on a frame member of the bag, this stud having bearings in which the terminals of a handle are journaled, there being a tongue secured to the companion frame member, for movement in a recess in the stud, so that the terminal of a bolt member, disposed for moving in a hollow portion of the handle and in a guideway in the stud, may move into an opening in the tongue to hold the tongue relatively to the stud and with the frame members together.

ELEVATOR WRENCH.—G. F. LEBUS, Electra, Texas. This inventor provides a device for use in rotary drilling machines for supporting the drill pipe and for holding it from rotation during the releasing of the several joints of the pipe when it is necessary to withdraw the drill from the well hole.

STRAIGHT EDGE.—G. W. PENN, 2112 Browder St., Dallas, Tex. The purpose in this case is to provide a tool especially adapted for paper hangers' use, wherein mechanism is pro-



STRAIGHT EDGE.

vided in connection with the straight edge, for compensating for warping or bending, to permit the edge to be returned to its original straight condition. With the present invention the straight edge will not warp so readily as the usual construction.

TONGS.—J. H. KUHNS, Tulsa, Okla. Address Cuny & Spillers, same place. The object here is to provide tongs wherein an operating lever or handle is provided with which cooperates a curved short lever or gripping jaw, the tongs being especially adapted for use with pipe or other articles of circular cross section, and wherein the article may be quickly grasped or released.

PIPE CUTTER.—J. T. BODKIN, care of City Water Co., Chattanooga, Tenn. The invention relates to devices for cutting pipe, more especially water pipe or other large pipe which is in use, for the purpose of making connections, etc. An object is to provide a device the use of which will save time, labor, and expense in cutting pipe.

EXTENSION LADDER.—P. E. JOHNSON and E. ANDERSON, 302½ 14th St., Brooklyn, N. Y. The invention provides a ladder capable of being extended in a very simple and secure manner. To accomplish this, use is made of extension side pieces connecting with each other by adjustable rungs or steps and adjustably secured to the main side pieces of the ladder.

SURGICAL INSTRUMENT.—N. C. MORSE, care of Emergency Hospital, Eldora, Iowa. The invention relates particularly to instruments for obstetrical purposes; and it is so constructed that the component parts thereof can be readily put together and readily separated from one another according to the necessities of actual practice; and when assembled they can be locked in any desired position of adjustment by the operator using the same.

ROCK DRILL.—M. SMITH, Bisbee, Ariz. The improvement refers to rock drills, and more particularly to the drill bits used in rock drilling and of that type provided with a side inlet through which either air or water, or both, may be introduced under atmospheric or forced pressure.

COMBINATION TOOL.—L. B. SMITH, College Place, Wash. This invention relates to a combination tool involving primarily a wagon or buggy wrench of novel form adjustable to adapt it to nuts or burrs of different sizes. Associated with the shanks of the wrench in practice, and co-acting therewith, are formed different tools.

Heating and Lighting.

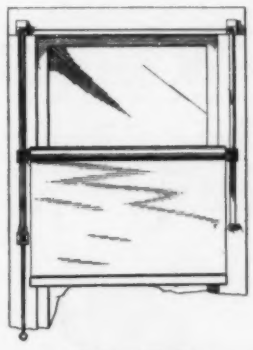
GASOLINE LIGHTER.—C. F. HOOFER, care of Hoofer Novelty Co., 324 Division St., Spokane, Wash. This device is capable of being carried in the pocket and the wick may be ignited by means of a spark struck from a body when abraded by steel, and wherein the movement of a single element extends the wick, strikes a stream of sparks in the direction of the wick, igniting the same, and wherein the wick when not in use is retained in a closed receptacle.

SAFETY EXTINGUISHER FOR LAMPS.—F. KRICH, 564 E. 158th St., Bronx, New York, N. Y. This extinguisher is for lamps burning oil, petroleum and like liquids, and is arranged to automatically extinguish the burner flame in case the lamp is upset, to allow of carrying the lighted lamp about by a person without automatically extinguishing the burning flame, but in case the person carrying the lighted lamp stumbles and loses hold on the lamp, then the flame is automatically extinguished.

Household Utilities.

SALT SHAKER.—A. MENDELSON, 482 Marcy Ave., Brooklyn, N. Y. This salt shaker prevents caking or lumping of salt within the cellar and secures a free discharge of the salt, and also provides for the return of any salt that may accumulate upon the outer face of the discharge plate.

SHADE HANGER.—W. TROJANOSKI, Patchogue, N. Y. The shade holder has two vertical guide-bars spaced apart, around each of which there is slidably disposed a guide member having a shade bracket, a cord being secured to one of the guide members, the cord passing over a member at the top of the guide bar on which the guide member is mounted and then over a member at the top of the other guide bar, a second cord being secured to the other



SHADE HANGER.

guide member and passing over a member at the top of the last named guide bar. The ends of these bars pass between clamp members for holding them with the guide members and brackets at predetermined heights. In the brackets there are recesses for the ends of the shaft of the shade roller and means provide for preventing the longitudinal movement of the roller relatively to the brackets.

TRAY HOLDING ATTACHMENT FOR BEDSTEADS.—S. A. BEECHIE, Box 325, San Marcos, Tex. This invention includes one or more shelves or trays adapted to be swung over a bed for the purpose of bringing food, drink, or other article into proximity to a patient. The trays are also adapted for vertical adjustment, and the vertical rod in which they are supported is secured to a bedpost detachably.

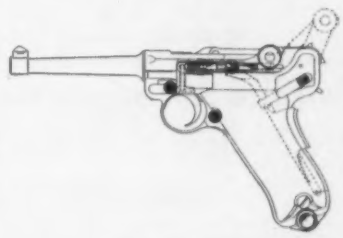
PERCOLATOR.—P. PONS and C. ARCHAMBAULT, Sylvan Lake, Alberta, Canada. This invention provides a percolator which can be manufactured in different forms, sizes and styles, by means of which infusions of varying degrees of strength can be prepared from tea, coffee, and other substances, with extreme rapidity, with employment of a minimum heat, which is well adapted for use by hunters, campers, prospectors and the like, as well as in the household.

BROOM.—H. J. STRUVE, care of The Deshler Broom Factory, Deshler, Neb. This invention relates more particularly to the long whisk brooms in barber shops and like places. The long fibers in these brooms do not properly reinforce one another and the strain exerted, due to their length, results in the fibers breaking off at the rear ends. Besides, the fibers do not offer the proper resistance for brushing. The present invention overcomes the stated defects.

Machines and Mechanical Devices.

FLEXIBLE COUPLING.—W. J. FRANCKE, New Brunswick, N. J. The object of this inventor is to provide a coupling arranged to insure the proper transmission of power from one shaft to another, even should such coupled shafts be out of line or out of center, to reduce the wear of the parts of the coupling to a minimum and to allow convenient replacing of worn out or broken flat springs or shims without requiring renewing of the keepers of the flexible connections.

HAND FIREARM.—M. NAVARRO and E. NAVARRO, Amiras 2, La Piedad, Mexico. The invention pertains to hand firearms of the Luger type, in which use is made of the recoil to render the firearm automatic as to ejecting shells and reloading. It provides improve-



HAND FIREARM.

ments in hand firearms of the above type whereby the firing may be produced periodically on the user pressing the trigger or the firing may be rendered continuous until all or a desired number of cartridges have been fired.

SHIP'S ENGINE ROOM SIGNAL.—O. K. BOGSTRAND, 179 Carroll St., Brooklyn, N. Y. This inventor provides a signal, embodying indicator instruments and a third member operatively connected with both of the first-mentioned instruments to disclose by the operation of the machinery if the directions transmitted through the signal instruments are put into effect; provides means for disclosing by the use of said instruments the condition of the machinery of the vessel; and simplifies the construction of the signal mechanism and installation.

PUMP.—J. E. WEAVER, Box 272, Twin Falls, Idaho. This invention relates more particularly to balanced compound pumps of the reciprocating type provided with translating plungers and swinging, reciprocating pump members. It provides a pump in which the power required to pump liquid is reduced to a minimum by balancing the moving parts of the pump.

OILER.—F. W. FLAVIN, Naples, S. D. The oiler is for use with crank or wrist boxes, or in any other position where it is desired to feed lubricant by force to a bearing or the like, wherein a container is provided for connection with the bearing or other part to be oiled and other mechanism operated by the moving of the rotating element for feeding the lubricant.

BRICK CLEANING MACHINE.—J. O. SWISHER, 615 Rosselle St., Jacksonville, Fla. The invention provides a machine especially adapted for removing mortar and the like from bricks to prepare them for reuse, and having mechanism for thoroughly cleaning the entire surface of the brick, and for finally discharging the brick in condition to be used again.

APERTURE GATE.—C. A. CURRIE, Sound Beach, Conn. This invention relates to attachments for moving picture machines, and particularly to that part known as an aperture gate, and has for an object to provide an improved structure for use in connection with films provided with a plurality of rows of pictures.

UNIVERSAL STONEWORKING MACHINE.—O. BAUER, 681 E. 29th St., Brooklyn, N. Y. Among the objects of the invention is the provision of an attachment for an ordinary polishing machine whereby the grinding wheel may be adjusted vertically simultaneously with the usual adjustments of the radius arms of the machine.

STAMP FEEDING MECHANISM.—J. IBARRA, Habana, Cuba. This invention provides mechanism having means for varying the speed of the feed of the stamps; provides a machine arranged to readily effect the duplex action; and provides adjustments for regulating the speed and the feed, access to which adjustments is easily and readily obtained.

CONCENTRATOR.—H. P. MCINTIRE, 445 S. 5th Ave., Tucson, Ariz. This device is for use in concentrating ores and is cheap to manufacture. An object of the inventor is to provide a device in which a great economy of water is effected, and having a large capacity in proportion to its size. The device is of a portable nature.

CEMENT TILE MAKING MACHINE.—C. F. R. KURTZE and W. GILLARD. Address the latter, Box 624, Stratford, Canada. The object of the invention is to devise a machine in which all manual labor will be dispensed with in removing the tile from the mold to the receiving table and the output thereof materially in-

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Inquiry No. 9399. Wanted the name and address of workers in ornamental polished stone.

Inquiry No. 9400. Wanted to buy an insoluble, non-fusible and opaque plastic material to be used in die moulds for manufacturing tobacco pipes of special kind.

Inquiry No. 9401. Wanted the name and address of the owner of a second hand aeroplane motor from 20 to 30 H.P.

Inquiry No. 9402. Wanted the name and address of a manufacturer who can make a tin toy.

Inquiry No. 9403. Wanted the name and address of a glass manufacturer who can blow a small glass article to order.

Inquiry No. 9404. Wanted the name and address of a manufacturer of a tool for cutting nicks in plate glass used for name plates and house numbers.

Inquiry No. 9405. Wanted the name and address of a manufacturer who is able to supply an attachable eyelet, aluminum or celluloid through which a snap fastener would work.

Inquiry No. 9406. Wanted the name and address of a manufacturer who can supply insole material in rolls. The material seems to be scrap leather composed and attached to a canvas bottom.

Inquiry No. 9407. Wanted the name and address of some patented mechanical device which saves money or time or both, which if properly handled will bring a large demand. It must not be too expensive. It may be electrical as well as mechanical. A first class article desired.

Inquiry No. 9408. Wanted the name and address of a manufacturer or distributor of a machine which will clean both single and double burlap bags; especially heavy bags.

Inquiry No. 9409. Wanted to secure a patented device which can be manufactured at small cost and around which a good business could be built.

Inquiry No. 9410. Wanted the name and address of manufacturers of "Scuffer Shoes."

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creased and thereby the tile made more economically.

POST HOLE DIGGER.—W. G. STOWES, Blacksburg, Va. The object here is to provide a device wherein separable cutting mechanism is provided, capable of detachment for repairs or replacement, and wherein mechanism is provided for connection with the cutting mechanism or bit for loosening the earth as it is cut, or before it is engaged by the bit.

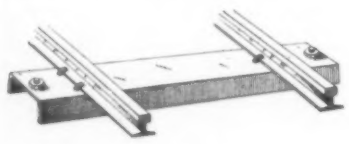
Prime Movers and Their Accessories.

SPARK PLUG.—H. J. BUTLER and DR. L. P. CASPER. Address the latter, 18th and Ormsby Sts., Louisville, Ky. The invention is for use with explosive engines or the like, and the object is the provision of a plug wherein the electrodes or sparking points are so formed that deposits of carbon and the like cannot accumulate on the points or electrodes, thus preventing the passage of the spark.

INTERNAL COMBUSTION ENGINE.—C. P. HINDS, care of Colorado Fuel and Iron Co., Calcite, Colo. The primary object here is to produce an engine which will contain few working parts to wear or get out of order, and which will provide ample room for the water jacket for cooling the same and being only a little larger than the average size two- and four-cycle engines for automobiles and similar purposes now in common use.

Railways and Their Accessories.

RAILWAY TIE.—A. KANGAS, 613 W. 3rd St., Ishpeming, Mich. This invention relates to the construction and maintenance of railways, and the main object thereof is to provide



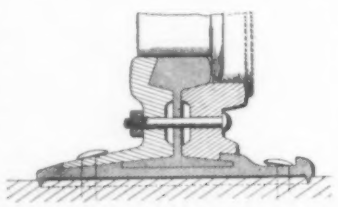
RAILWAY TIE.

a permanent tie for rails of such railways. A further object is to form the ties of metal, preferably channeled, and to provide rail clamps in connection therewith which are in uniform position on all the ties.

AUTOMATIC TRAIN STOP.—B. D. TRIPP, 50 Church St., Binghamton, N. Y. This invention has particular reference to means for automatically controlling the operation of railway trains whereby the brakes will be applied in the event of the failure or incapacity of the engineer to observe danger signals or in case the locomotive wheels should leave the rails.

AUTOMATIC TRAIN CONTROL SYSTEM.—M. L. WINN, Russellville, Ark. This invention relates to systems used for stopping or otherwise affecting moving trains by aid of an apparatus which is itself controllable by movements of trains. It is of special application for enabling a train, passing along a track, to actuate movable arms spaced at intervals along the track in such manner as to raise and lower these arms one at a time.

RAIL JOINT.—W. M. GLOTFELTY, Ohiopyle, Pa. The primary purpose here is to provide a joint that will bring about a practically continuous rail which will relieve the rolling stock from all shocks, jolts and jars in passing there-



IMPROVED RAIL JOINT.

over, and which will operate with equal facility in connection with either the standard car wheel now in use or a specially constructed car wheel which the inventor prefers in time to introduce. The dotted lines in the drawing show the special type of wheel and how it is supported at the joint.

RAILROAD TIE.—O. P. MEGAHAN, Westerville, Ohio. This invention relates to improvements in steel railroad ties, and the object is to provide a steel tie so constructed that while insuring the desired resiliency of the portions to which the rails are secured, will reliably support engines of the heaviest type.

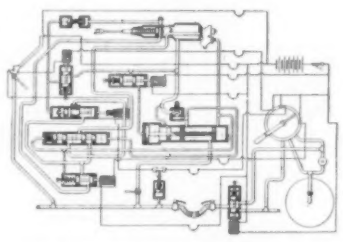
AUTOMATIC TRAIN CONTROL.—C. H. GOODPASTURE, care of Byron Millett, Olympia, Wash. The invention provides a roadway with a continuous series of signals arranged in pairs, the signals of each pair being on opposite sides of the railway track and spaced at a distance equal to two blocks, the signals of the next pair being arranged to lap over or break joints with the preceding pair, where a reliable interlocking block signal system is provided.

MINE CAR DOOR LATCH PLATE.—J. R. FLEMING, 801 Monroe Ave., Scranton, Pa. Among the principal objects which the present invention has in view are: to protect the wooden frame forming the door opening; to provide reversible latches; and to simplify and cheapen the construction of cars of the character named.

SCOTCH BLOCK FOR STOPPING RUNAWAY RAILWAY OR TRAMWAY VEHICLES.—A. H. STOCKHAUSEN, East Adelaide, and W. G. BRINKWORTH, Adelaide, S. Australia, Australia. The block consists of a bed and a projection rigidly fastened together or formed of one piece and having upon one side a spring catch engaging a rocker pivoted to the track and connected to a suitable operating lever. The rocker is operated and the block set upon the rail or removed therefrom either by a lever alongside the track, or it may be operated by a lever and rods from a convenient cabin.

STATION PLATFORM.—C. M. SWEDBERG, 13 Willow Place, Yonkers, N. Y. The invention relates to subway and other station platforms where the track is curved, and deals especially with means for closing the gap or bridging the space between the curved track side of the platform and the body of the cars at the doorway thereof, so that accidents to persons entering or leaving the cars are effectively avoided.

ELECTROPNEUMATIC AIR BRAKE SYSTEM.—J. P. COSTELLOE, care of O'Flaherty, 6 W. 107th St., New York, N. Y. This invention provides a simple brake system which can be easily and at little cost applied to standard automatic fluid brakes, which is automatic in action and uniform in operation, and which



ELECTROPNEUMATIC AIR BRAKE SYSTEM.

will actuate the brakes simultaneously throughout the train. It also provides a brake system which will permit the use of the same as a standard pneumatic system or as an electropneumatic system; and the change from one to the other can be made simultaneously.

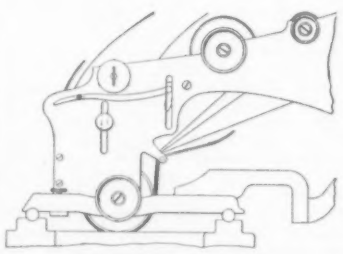
Pertaining to Recreation.

CONVERTIBLE DUMB BELL.—A. J. LATELLA, 316 Baltic St., Brooklyn, N. Y. This improvement refers to a dumb-bell of the convertible type, that is to say, it can be converted from an elastic or yielding dumb-bell to one resembling a solid dumb-bell, the weights of which are adjustable, whereby the article is of universal application.

COMBINED CIGAR LIGHTER AND CUTTER.—L. B. GRASBERGER, General Delivery, Richmond, Va. An object of the invention is to provide a device by means of which a cigar cutting or clipping mechanism may be operated simultaneously with the lighting mechanism at a single movement. A further object is to provide means for returning the parts to normal position when the device is not in use.

COMPUTING MECHANISM.—J. V. SOUDER, 379 Prospect St., Meadville, Pa. This improvement is adapted to be used with any desired mechanism, as, for instance, it may be combined with a recording machine in the form of a typewriter and associated with the mechanism thereof, so as to be operated by the usual number of keys provided on that kind of mechanism.

TYPEWRITER APPLIANCE.—E. E. KASER, W. V. HUMBLE, and E. G. REMMERS. Address the last, Majestic Bldg., Oklahoma, Okla. The appliance permits the paper in continuous strips to be used in the typewriter, thereby economizing in time, by eliminating removing and replacing separate sheets of paper. To this end mechanism is provided for supporting



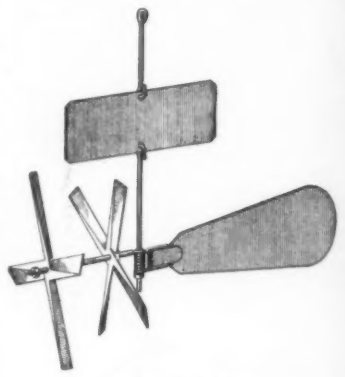
TYPEWRITER APPLIANCE.

rolls of paper suitable for fair and carbon copies, and a roll of carbon or impression paper, and for conducting the said strips in superposed relation beneath the platen roll of the typewriter, and for severing the strips of paper transversely into sheets of suitable size, after they have been written upon.

GAME APPARATUS.—JOHANNA L. RYAN, care of C. A. Thurow, 269 S. Clinton Ave., Rochester, N. Y. This invention has for its object to provide a game apparatus having a board with a side wall therearound, there being at one side of the board an inclosure with two openings into which a player may roll a number of marbles. Means are provided to act as guides and obstructions in rolling the marbles into the openings in the inclosure.

TOY AEROPLANE.—F. REISS, Collingswood, N. J. Among the objects of the invention is to provide a toy adapted to be projected into the air either by means of a catapult, crossbow or some other means, the device being so constructed as to glide gently to the ground after being so projected.

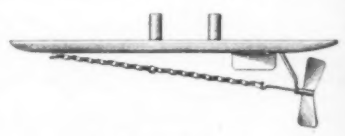
TOY.—H. C. BALDWIN, Lakemont, N. Y. The design of the invention is to provide an attractive toy, and one that may be made to serve the purpose also of a weathervane. It is so constructed with regard to the frame, bearings, etc., that the device will operate even in an



TOY WINDMILL.

exposed place for a long period without attention or repairs. A single piece of wire is formed to constitute the frame having a shaft or axle about which the wind wheels revolve, a socket or sleeve for a suspension rod, and means for the connection of the weathervane.

TOY MOTOR BOAT.—H. BERGH, 109 W. 75th St., Manhattan, N. Y., N. Y. The invention provides a prime mover, the motive power whereof may be readily and quickly renewed; provides a toy the parts whereof are easily and

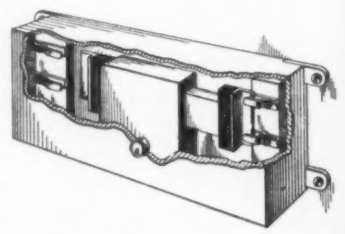


TOY MOTOR BOAT.

readily renewable; provides a toy the parts whereof may be separated for transportation and quickly and readily assembled; and provides a toy with a simple and efficient rudder.

Pertaining to Vehicles.

SAFETY ELECTRIC CIRCUIT SYSTEM.—W. BOLGER, Maple Ave., Hastings-upon-Hudson, N. Y. The invention provides a key controlled, movable lock bolt having on each end a bridge adapted to connect two adjacent springs, each pair of springs being in circuit with a single battery and being associated with any usual or well known ignition controlling switch mounted



SAFETY ELECTRIC CIRCUIT SYSTEM.

upon the dash board, or the like, of the vehicle, whereby, when the vehicle is left in locked condition with the ignition switch open, a stranger attempting to start it will first turn the switch into operating position, causing the sounding of an audible alarm, and without being able to start the engine because of the break in the ignition circuit.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

WE wish to call attention to the fact that we are in a position to render competent services in every branch of patent or trade-mark work. Our staff is composed of mechanical, electrical and chemical experts, thoroughly trained to prepare and prosecute all patent applications, irrespective of the complex nature of the subject matter involved, or of the specialized, technical, or scientific knowledge required therefor.

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Notes for Inventors

New Deeds Required for Huerta Patents.—Recognizing that patents for inventions and trade-marks, issued while Huerta was in power, were lawfully granted under a law that considerably antedated that *regime*, and that they are protected by international convention, the Mexican Patent Office has rescinded its previous order voiding such patents and trade-marks. It will be necessary, however, for all patentees who obtained their grants during the Huerta *regime* to procure new title deeds if they wish to maintain their rights. These deeds will be issued on application, and without the payment of the small fees that were required under the previous ruling.

A Charles P. Steinmetz Vapor-Rectifier System.—Patent for the invention of Charles P. Steinmetz, No. 1,097,062, provides improved means for exciting mercury rectifiers utilized in converting alternating current into uni-directional current in vapor-rectifier systems.

New Textile Effects in Printing.—William Berry of Nunhead, England, has patented, No. 1,097,075, a method of printing by which to secure more realistic textile or other effects for use in advertising leaflets or posters, picture postcards, etc.

An Automatic Train-Stop.—In patent No. 1,097,457 Paul Neree Mathis of New York city provides a train-stop by which to prevent cars equipped with air brakes from passing a danger signal except under direct orders and at slow speed.

An Eye and Nose Guard.—Pablo Horacio Cordovia of Havana, Cuba, has secured patent No. 1,097,538 for a protector for the eyes and nostrils against dust and other flying particles.

Wire Nails for Railway Ties.—To protect wooden railway ties against crushing strains patent No. 1,097,564 has been issued to Andrew Stark of Chicago, in which a multiplicity of wire nails are set in the material of the tie immediately under the rail.

A Novel Amusement Apparatus.—George C. Hale of Kansas City, Mo., in patent No. 1,097,627 shows an amusement apparatus for exhibiting at low altitudes pictures taken from lofty points, so that persons who because of weak or nervous condition cannot go to high altitudes, can enjoy the scenery visible from such points.

An Improved Submersible Boat.—Patent No. 1,108,192, issued upon the invention of Gustav M. Lagergren of New London, Conn., is for a submersible boat in which is provided an improved operating mechanism for the hydroplanes or steering blades so that they may be conveniently brought into any desired steering position and as easily caused to assume an inoperative position against the sides of the vessel.

Three John Scott Medals Awarded by the City of Philadelphia.—The City of Philadelphia, acting on the recommendation of The Franklin Institute, has made awards of the John Scott Legacy Medal and Premium to Adolph Spielman, of Philadelphia, for his Cloth Cutting Machine; to Jesse W. Reno, of New York, for his Escalator, and to Charles S. Batdorf, of New York, for his Coin Counting and Wrapping Machine. Mr. Spielman's invention is an electrically-driven portable machine which cuts up to 150 thicknesses of material at one time to any desired pattern. The cutting is performed by an endless chain, the links of which are made in the form of knives, and which travels at a rapid rate. The escalator of Mr. Reno is for carrying persons from one level to another in comfort and safety. It consists of an inclined endless belt made in small sections hinged together. Projections on the landings register with the links and enable the passengers to step on and off the device without timidity. Mr Batdorf's coin counting and wrapping machine accurately counts and wraps coins of one, five, ten, twenty-five or fifty cent denominations into crimped cartridges containing twenty, twenty-five, forty or fifty coins as desired. The machine handles 350 coins a minute and rejects counterfeits automatically. It is now in use in several banks.

A Typewriter Improvement.—Thaddeus Cahill, of New York city, has secured a patent, No. 1,097,789, for a typewriter designed to prevent the operator from printing letters one on top of the other at the end of the line.

Shielding the Cigar from the Wind.—Edward S. Clifford of New York city, has patented, No. 1,106,495, a wind shield for lighted cigars in the form of a thimble or tube closed at its outer end and so fitted loosely over the lighted end of the cigar as to provide air passages around the body thereof.

Improved Wireless Antenna.—In patent No. 1,106,945 Nicholas J. Jeffries of Atlantic City, N. J., provides an improved form of antenna which is portable, collapsible and extensible, can be employed as either a transmitter or receiver and quickly hung from the limb of a tree or other support.

Economizing Space in Railroad Cars.—In patent No. 1,106,169, John G. F. Thomas of Chiswick, England, economizes space in railway motor coach by sloping the floor downwardly from the middle toward both ends and locating the motors or engine between the central elevated or raised portion of the floor.

Illustrating the Operation of Stock Exchange.—A game device has been patented, No. 1,106,090, by Charles H. Gessner of Bergenfield, N. J., which is designed to illustrate by suitable apparatus the method of operation on the various exchanges of the country, particularly the stock exchange.

Multiplex Record Holder for Sound Reproducer.—Hyman E. Markel of Nashville, Tenn., in patent No. 1,111,716, shows a sound reproducing machine having a novel construction for bringing successively into operative position the cylinders arranged in series.

A New Gillette Razor Patent.—King C. Gillette of Brookline, Mass., has secured patent No. 1,111,721 for a safety razor which includes novel features in the handle devices and in the means for securing the blade and facilitating its application and removal.

Buttoning False Teeth into Place.—Grover C. Otrich and Julius L. Bischof, of Bellville, Ill., have secured a patent, No. 1,101,810, for securing dental plates in position in which snap fasteners are employed, the ball being anchored to the jaw and the socket carried by the dental plate.

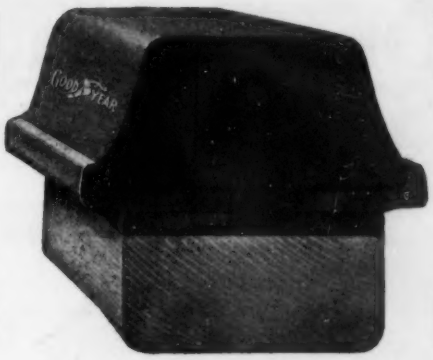
A Phonographic Record Holder.—Fred Evans, of Summit, and Malcolm Campbell, of Englewood, N. J., assignors to Patented Devices Company, New York city, present in a patent, No. 1,101,623, a phonographic record holder, in which disk-shaped partitions are supported between standards.

A Pistol which Illuminates the Target.—The purpose of patent No. 1,095,686, secured by Albert Lee Webb of Sudbrook, Md., is to illuminate the target and to indicate by a fuller or brighter light the sighting point. The broad idea is not new, as readers of the SCIENTIFIC AMERICAN know, but this modification is interesting.

Cumulative Antennæ Effects.—Walton Harrison, of Brooklyn, N. Y., in a patent, No. 1,097,974, provides a receiver for wireless communication in a system in which the responsive effect of a number of antennæ and separate wave detectors is rendered cumulative and thereby made more distinct, and also rendered less irregular.

Motion Acts Combined with Moving Pictures.—Jacob Saudek, of New York city, has obtained patent No. 1,099,207, for combining motion acts and moving pictures. After the cessation of the living impersonations the moving picture apparatus instantly reproduces in succession the impersonations previously portrayed upon the film.

A Wireless Telegraph Patent Granted to Lee de Forest.—Lee de Forest, of New York city, in a patent, No. 1,101,533, presents a system of wireless telegraphy in which the horizontal receiving antenna is divided into two parts, each connected with an intermediate detector and corresponding with a substantially horizontal transmitting antenna.



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Legal Notes

Attorney Joseph B. Church Dies.—Joseph B. Church died on June 26th at his residence in Washington city. Mr. Church was a well-known patent attorney, having entered the profession in 1883 in association with his brother Mr. Melville Church. Prior to this, he was an official of the Patent Office, resigning the position of examiner of interferences during the incumbency of which he rendered the decision in the celebrated telephone interference case. He, from his earliest practice, held a high place in the profession, and was much esteemed for his ability and sterling qualities.

A Decision on Reduction to Practice.—In Thomas vs. Stewart, Commissioner Ewing has held that where an inventor has sold or parted with the property rights to an invention which has not been reduced to practice by him, and the owner of such property rights has caused the conception to be reduced to practice with reasonable diligence, the right of such owner is secure, whether or not the inventor contributed to the reduction to practice. In the course of his decision, the Commissioner suggests that it frequently happens that inventors of ability are not good in matters of construction, or are so absorbed in their creative work as not to be interested in the detail involved in a reduction to practice.

Limitation Omitted from Some Claims.—It was held in Rollman Manufacturing Company v. Universal Hardware Works that where a limitation expressly stated in some of the claims of the patent is omitted from others it cannot be read into them to avoid a charge of infringement.

Terrorizing a Trade.—It has been held in Atlas Underwear Company v. Cooper Underwear Company, 210 Fed. 347, that an injunction would be granted to restrain the owner of a patent from attempting to enforce his rights by terrorizing the trade or customers of competitors through a succession of threats which he never attempts to carry out. In another case, Clip Bar Manufacturing Company v. Steel Protected Concrete Company, 209 Fed. 874, the court held that notice of infringement given by the owner of a patent to customers of a manufacturer of a similar article, and even threats of suit, if in good faith, are within its rights and not actionable as acts of unfair competition.

Registration Renewals Not Subject to Examination.—The Court of Appeals of the District of Columbia, in the case of Commissioner of Patents v. Standard Oil Company of New York, has held that the renewal of a trademark registration confers no new rights, and that a request for renewal is not subject to examination as in the case of an original application.

The Steinberger-Hewlett Interference.—The United States Circuit Court of Appeals in General Electric Company v. Steinberger has affirmed the decision of the District Court, Eastern District of New York, decreeing that Hewlett was the first inventor and entitled to a patent. Previously in the Patent Office in the interference involving Hewlett's application and Steinberger's, the other party's patent, the Examiner of Interferences had awarded priority to Hewlett, and the Board of Examiners in Chief affirmed his decision. The Commissioner of Patents reversed the decision and awarded priority to Steinberger and the Court of Appeals of the District of Columbia affirmed the Commissioner's decision. Now the United States District Court and the Circuit Court of Appeals have gone back to the decision of the Examiner of Interferences. The Circuit Court, however, pointed out that the suit was in no sense an appeal from the Court of Appeals of the District of Columbia, there being testimony in the record which was not before that tribunal. The case turned upon a sketch sent by Steinberger to a co-worker of Hewlett, the important point being whether the sketch disclosed the subject matter of the invention in interference. The Circuit Court held it did not. It is interesting to note the question of priority of invention as between these two inventors was the subject of six decisions, the first, second, fifth and sixth being in agreement and differing from the third and fourth.

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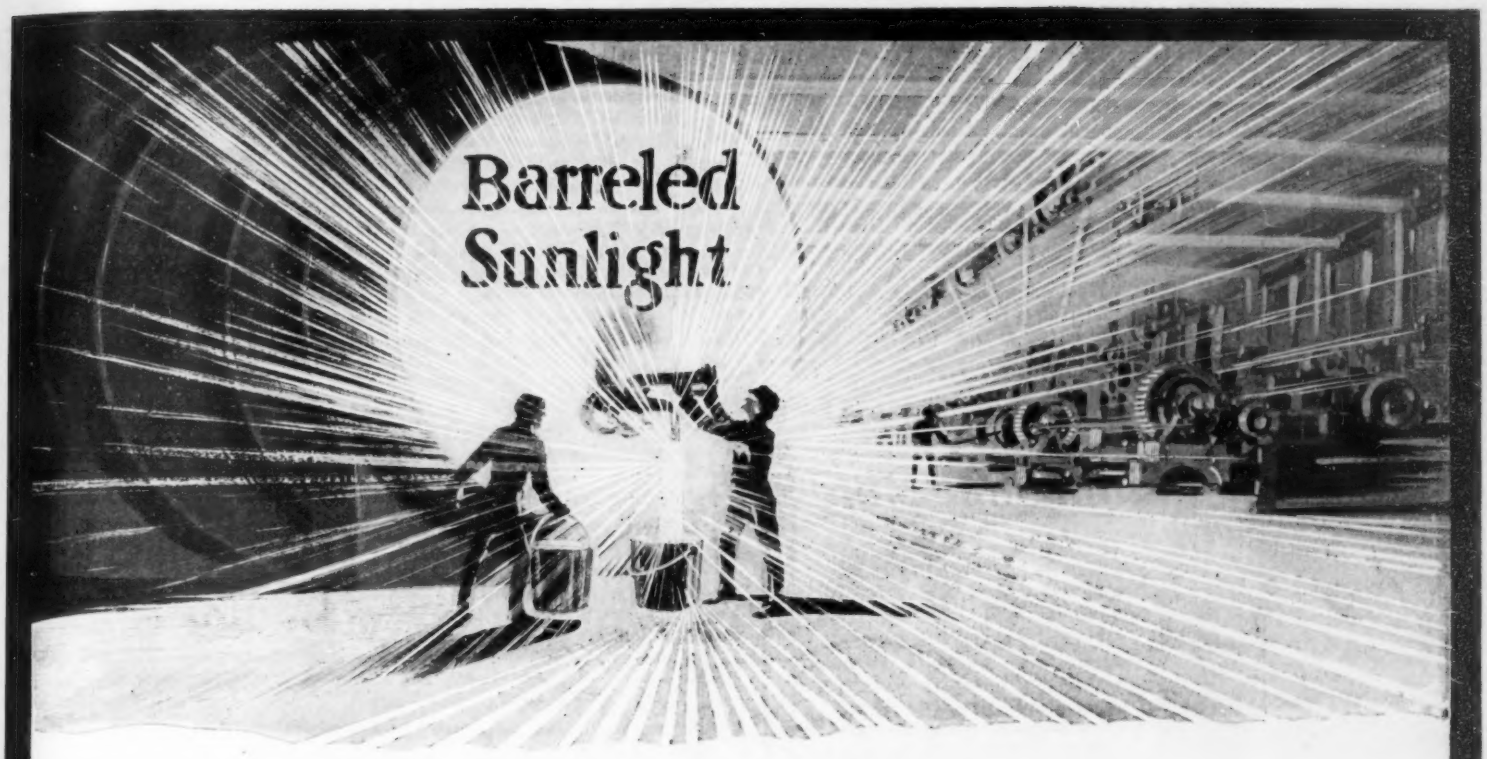

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Royal Typewriter Co., Hartford, Conn.
General Fire Extinguisher Co., Providence, R. I.
Waltham Watch Co., Waltham, Mass.
United Shoe Machinery Co., Beverly, Mass.
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Lancaster Mills, Clinton, Mass.
Whitin Machine, Whitinsville, Mass.
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West Point Mfg. Co., West Point, Ga.
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Massachusetts Mills in Georgia, Lindsdale, Ga.
The Pell City Mfg. Co., Pell City, Ala.
Indian Head Mills of Alabama, Cordova, Ala.
Pelzer Mfg. Co., Greenville, S. C.
Waterbury Farrell Foundry and Machine Co. Waterbury, Conn.
Tremont and Suffolk Mills, Lowell, Mass.
Whitman Mills, New Bedford, Mass.
Diamond Chain and Mfg. Co., Indianapolis, Ind.
Chadwick-Hoskins Co., Charlotte, N. C.
Merrell-Soule Co., Syracuse, N. Y.
Brighton Mills, Passaic, N. J.
Renfrew Mfg. Co., Adams, Mass.
Hood Rubber Co., Boston, Mass.
Greylock Mills Co., N. Adams, Mass.
Utica Steam and Mohawk Valley Cotton Mills, Utica, N. Y.
Dwight Mfg. Co., Chicopee, Mass. and Alabama City, Ala.
Wm. A. Slater Mills, Jewett City, Ct.
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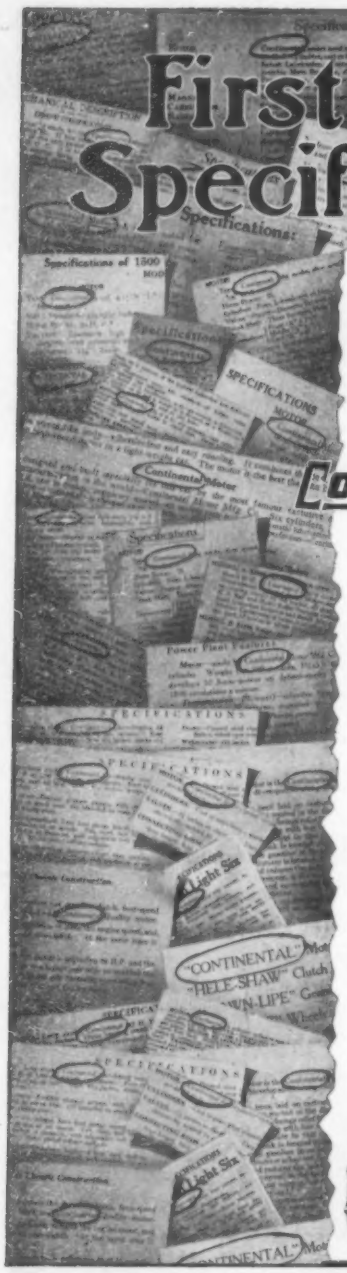

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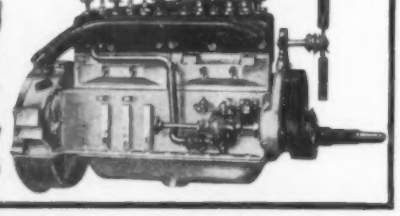

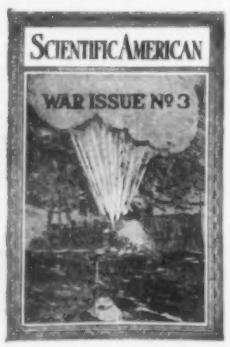

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The Military Resources of Turkey

(Concluded from page 459.)

and has captured or sunk some of the Russian merchant fleet. The most important engagement was one between the "Moltke" and a squadron of Russian battleships and cruisers, in which each claimed the advantage. The Turks state that a Russian battleship was severely damaged, and with the other Russian war vessels fled to Sebastopol. The Russians claim that a division of the Black Sea fleet, returning from a cruise to Sebastopol, engaged the "Goeben" and the "Breslau." They state that the 12-inch guns of the flagship "Admiral Edstafry" landed with damaging effect upon the "Goeben" which, utilizing her great speed, withdrew and joined the "Breslau." This vessel, being an unarmored ship, took no part in the fight.

Field Gun and Aerial Projectiles

(Concluded from page 453.)

producing material at *F* is intended to increase the visibility of burst. As the two explosions are separated by a considerable distance, the chance of fragments' hitting is increased, and the flame from *B* would explode a balloon. The efficiency of the projectile for land warfare has not been appreciably decreased by these modifications.

Bombs or "drop projectiles" adapted to be dropped from aircraft are of relatively simple construction, as they do not have to withstand the accelerating force of powder gas. A typical projectile is shown in Fig. 7. The firing pin *A* is locked by the screw *B* to make explosion impossible during transportation or on landing. A safety wire *F*, which is removed before dropping, is an additional safeguard. When the bomb is dropped the resistance of the air causes vane *C* to rotate, which unscrews the screw *B* and releases the firing pin *A*. A stop pin *G* keeps the firing pin from rotating, but does not interfere with its forward motion. On impact the firing pin *A* strikes the detonator *D* and explodes the high explosive charge *E*.

It is rather early to predict the ultimate use of such bombs, but in so far as field armies in the present war are concerned, it is safe to say that due to the limited weight that the largest airship can carry their effects will not be any more terrifying and will be far less important than those of the enormous number of gun projectiles, which are thrown with greater accuracy and usually from guns that cannot be seen by those attacked.

Among recent United States patents may be found several assigned to Fried. Krupp Aktiengesellschaft, on searchlight projectiles. These projectiles are arranged to burst in the air, throwing out a number of "candles" or luminous bodies that light up the surrounding country for a considerable area and reveal the movements of the enemy. Each candle is provided with a parachute that unfolds as soon as it has been discharged from the cell, so that the candle will drop very slowly and will burn for a long time before striking the earth. The arrangement of such a projectile is shown in Fig. 8. It is similar to a base chamber shrapnel, and is provided with the usual time fuse *A* and bursting charge *B*. The interior of the shell is provided with a number of candles each fitted in a casing *C*. The fuse is set to burst the projectile when it is on the descending part of the trajectory, and as soon as the candles are disengaged from the shell, the caps *D* are thrown off by a spring *A*, which releases the parachute *F* (see Fig. 9). At the same time the candle is ignited by means of the match *G*. After their ejection the candles fall slowly to the ground, while the light material *H* burns brightly.

The accompanying drawing illustrates the effect of one of these shells in disclosing the movements of the enemy without betraying the position of the gun from which it was fired.

A Hiram Maxim Silencer for Gas Engines.—Hiram Percy Maxim of Hartford, Conn., has secured patent No. 1,111,265 for a silencer for gas engines including a novel construction of deflecting means within the casing body.

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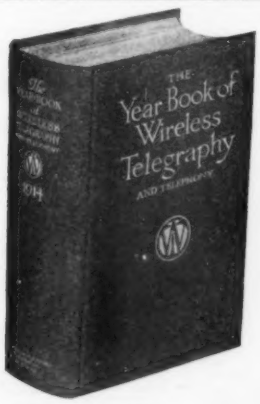

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FINALLY we were all ready. The machine was completely assembled and had made a trial flight. We were both in, ready to start. The evening before we had received our orders to make a round trip of 236 miles over the enemy's country. Would we be able to make it with the fuel tanks we had? We had figured on a 186-mile flight as the longest. How we were envied—we who were to make the first reconnaissance!

At 3 o'clock we started in scorching heat. If only we do not have a motor breakdown! Throughout 200 miles we shall be over the enemy's country. The inhabitants are bestial. If we are forced to descend after an hour's flight over their soil, it will take us three days to walk back. But the Mercedes is running fine and steady as a clock. As we cross the border we give three "Hurrahs!" Two beings in a world of their own! We are 2,300 feet high as we enter the enemy's country. Our course is to Verdun and beyond. A cautious man takes no chances, so we rise to 5,000 feet, as we do not know how high we must fly in order to be out of range. The roads leading to the Maas were empty and the villages deserted. Where were the enemy's troops? We had expected they would defend a part of the river. After a 1½-hour flight its waters shimmered below us in the sunlight. The scene was one of peace. So perfectly did the motor run that our confidence in it increased every minute. We no longer watched the revolution indicator nor listened for skipping of explosions. Just as I looked back to enjoy the wonderful scene my companion, with an exclamation of delight, pointed out the first French troops, who were in a few scattered camps east of Verdun, while northwest of that place they became thicker. Soon we saw them moving in different places. West of Verdun we saw a broad, thin streak of smoke. We had been shot at. We laughed sarcastically and kept right on our way. Twenty miles west of Verdun we turned in a wide curve. As we were nearing the mass on the return trip we saw a French biplane start up and climb rapidly. In a trice the Frenchman climbed to within 650 feet of us. Had I tried to make a detour he would have cut across. He was climbing very fast and we watched him with great anxiety. Soon we were almost upon him, climbing ourselves to keep above him. Next he was just below our left wing. Then he was behind us. We laughed joyfully, for we had known all the time that we were faster than he. Our machine was also a better climber, for we were 1,000 feet above the French one as we passed.

And now, Home! We had 62 miles to make and but 40 liters of fuel to fly the distance. Our motor consumed 35 liters an hour, but we hoped we would make it somehow. We reduced the revolutions about forty in the endeavor to save a little fuel. My companion read the speed indicator and found we were making over 71 miles an hour, so we figured we would just be able to reach home.

Finally we were over German troops again. We breathed a sigh of relief. If the motor stopped now it mattered but little, as we would land among friends. But our faithful Mercedes brought us safely back to our starting point. We had made a four-hour flight, yet we still had 8 liters of gasoline left in the tank. Our comrades received us joyfully, glad that we had returned safely with information about the enemy. One of my mechanics, after looking over the surfaces, cried "Three hits!" and pointed to three bullet holes through them. We had flown too low, after all. Now we know, from bitter experience, if we fly at less than 1,000 meters (3,280 feet) we will be brought down almost every time. Only after we reach a height of 1,700 meters (5,576 feet) are we fairly safe from infantry fire.

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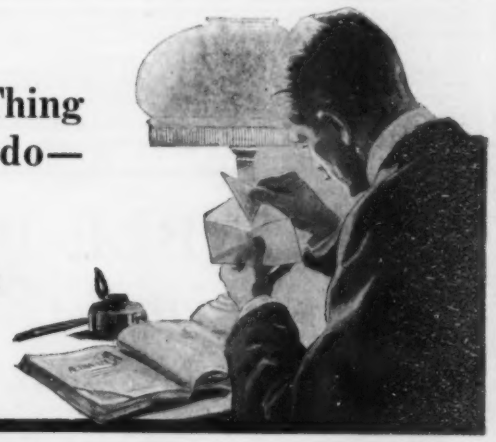

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while when over the enemy's country under conditions of war time fairly races by, setting one's nerves on edge and riveting one's attention on the work in hand. "Where can you land if the motor stops?" This one thought that is uppermost in your mind in times of peace does not occur to you now. You fly straight ahead without giving a thought to where you will land or what will happen if the motor fails.

This was the first flight with my fine A. E. G. machine above hostile soil. Valuable information was obtained and the authorities were greatly impressed. Five weeks have since passed and the machine has flown some 2,000 miles. The three bullet holes have increased to nine. All were without serious damage. The tenth struck the propeller at a height of 4,600 feet. I was flying at a height of 6,500 feet in clouds. As I emerged I was over hostile troops, who opened fire. Suddenly the machine was struck a hard blow. A bullet had hit the running gear and rebounded against the propeller. A splinter 6 inches long by ¾ inch wide was broken off, but the propeller still worked well enough for me to return to my starting point.

I always supposed that during a flight of several hours' duration I would come upon numberless French machines. You only find them, however, over their own troops. They are no good for going out long distances and bringing back information, but for fighting they are first rate. The French aviators rise from behind the battlefield 100 meters in a jiffy without running any risk of being shot down, take a glance or two at the disposition of our troops, and as quickly descend again and alight. It looks as though they use their large heavy machines for defense alone. "Peasant-scarers" is what we have dubbed a giant, steel-colored Farman biplane which carries a machine gun and has chased and hit a number of our fliers, but without doing serious damage.

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Concrete Freezing

THE use of chloride of calcium is recommended by some authorities to prevent the freezing of concrete. It is a well-known fact that solutions of different salts are more difficult to freeze than pure water, for instance a 20 per cent common salt solution only freezes at 14 deg. C. below the freezing point of water, and a chloride of calcium solution freezes at a still lower point, or 18 deg. C. below. This phenomenon can be made use of in connection with concrete working, and such solutions are used when preparing the material so as to lower the freezing point. In this way it is possible to carry out work with concrete even during very great cold, which would not be practicable by the ordinary process. It is better to use chloride of calcium instead of common salt for such work, as the former salt increases the waterproof quality of the concrete and is much preferable for this reason. Experiments have been made in order to determine the best amount of chloride of calcium to use in the mixing, and after a number of trials made by forming bricket proof pieces and then testing these, it was clearly shown that the best resistance of the specimens was given by using 2 per cent chloride of calcium. Since there is commonly used from 10 to 15 per cent of water in mixing the concrete, the addition of 2 per cent chloride of calcium means that a 15 or 20 per cent solution is employed, and this lowers the freezing point of such water to 10 or 18 deg. C. below freezing point of water respectively. Adding more than 2 per cent of the salt is found to increase the speed of setting, but it is remarked that concretes are less resistant as the setting is quicker, so that it is not well to go higher than the foregoing figure.

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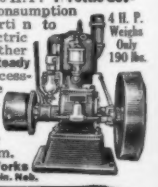

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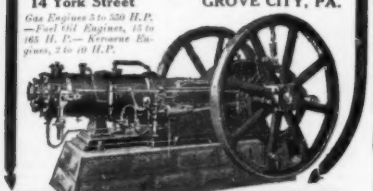

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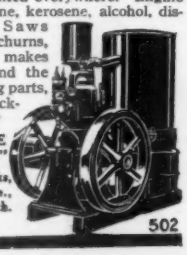

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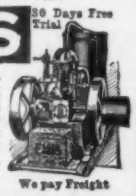

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PICK, SHOVEL AND PLUCK. Further Experiences With the Men Who Do Things. By A. Russell Bond. New York: Munn & Co., 1914. 12mo.; 5¾ x 8¼. 255 pp.; 110 illustrations including 58 page-plates and colored frontispiece. Price, $1.50; postpaid $1.65.

The complexity of the details of engineering are apt to lead the layman into accepting everything connected with the profession as a baffling mystery to all who are not actively engaged in its intrica ies. While the stupendous engineering accomplishments of the age awaken within the everyday man an appreciation of the fact that unerring technical skill of the highest order has been brought to a marvelous state of development, this same person has not, perhaps, a conception of what might be called the romance of engineering, the play of that ingenuity which is called forth to meet unexpected problems, the very hazard often experienced in great undertakings, in fact the spectacular battles of brain and brawn with the inanimate world. In "Pick, Shovel and Pluck" Mr. A. Russell Bond, the author, has achieved the success of lucidly explaining the work of engineering and the tasks of the engineer in language at once clear, direct, simple and forceful, and in such a manner that it holds compelling interest whether the reader be versed in the technicalities of the subject or is ignorant of them. "Pick, Shovel and Pluck" is not below the keen appreciation of the adult, and yet any schoolboy will understand it and find delight in its pages, for the subject treated by Mr. Bond is in the form of a narrative. As the author says in his preface: "For the adventures it was not necessary to draw upon the imagination. Actual engineering work furnishes plenty of novel experiences, some of which seemed so extraordinary as to be almost incredible. Take the adventure in the last chapter, for instance: To have a huge slab of stone drop on a ledge in such delicate poise that it could be rocked like a monster seesaw by the weight of a boy seems almost beyond belief. Yet at a different time, in a different place, with a different hero, this actually took place. The story is vouched for by the head of a reliable house-wrecking company. In fact, every story in this book, no matter how unreal it may seem, is based on fact. As the subtitle indicates, the present book is a sequel to 'With the Men Who Do Things,' which told of two boys who spent a summer in New York, studying the big engineering undertakings in and about the city. The present volume takes the same boys away from New York, and gives them a wider variety of engineering experiences, reaching from the Panama Canal to the Keokuk dam across the Mississippi, and finally, in the last eight chapters of the book, bringing them back to New York. As in the previous book the calendar has been ignored, and engineering undertakings that date back many years are staged in the same year with those that have hardly yet begun. As the primary object of this book is to instruct, every precaution has been taken to secure absolute accuracy of all the engineering data."

THE NAVAL CONSTRUCTOR. A Vade Mecum of Ship Design for Students, Naval Architects, Shipbuilders and Owners, Marine Superintendents, Engineers and Draughtsmen. By George Simpson, Member of the Institution of Naval Architects, Associate Member American Society of Naval Engineers. New York: D. VanNostrand Company, 1914. 12mo.; 819 pp.; illustrated. Price, $5 net.

This handbook has been favorably received since its first appearance in 1904, and now reissues in a revised and enlarged form that must still further commend it to designers and builders. The earlier editions were especially noteworthy for their unification of details; the present edition continues that feature and includes new material of which the paper on ventilation is an example. The seven sections which comprise the work are devoted to ship calculations, strength of materials, fittings and details, rigging and ropes, equipment, miscellaneous, and tables. It is a very compact volume of authoritative information.

DAVISON'S TEXTILE "BLUE BOOK." United States and Canada. 1914-1915. New York: Davison Publishing Company. Price, office edition, $4; pocket edition, $3.

Each year we have occasion to call attention to the merit of this directory. It contains the cotton, woolen, silk, jute, flax and linen manufactures the dyers and bleachers, the mattress manufacturers, commission merchants, converters and brokers, and yarn dealers; the dealers in cotton, wool, hair, waste, and rags, and the merchants in raw, thrown and spun silk. It constitutes a classified list of the cotton and woolen mills and includes a directory of mill supplies. Its uses and its value are evident from the mere mention of its scope. A number of maps add to the efficient service the work offers.

CYCLOPEDIA OF AMERICAN GOVERNMENT. Edited by Andrew C. McLaughlin, A. M., LL.B., LL.D., and Albert Bushnell Hart, Ph.D., Litt.D., LL.D. Three volumes. New York: D. Appleton & Co., 1914. Price, $22.50 net.

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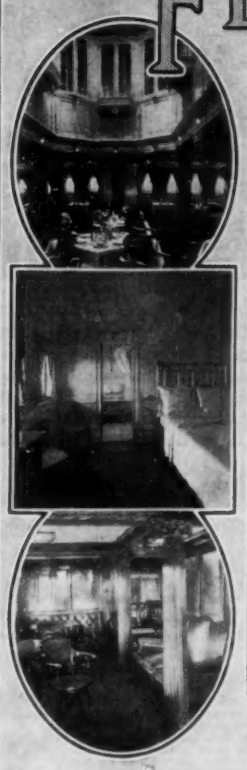

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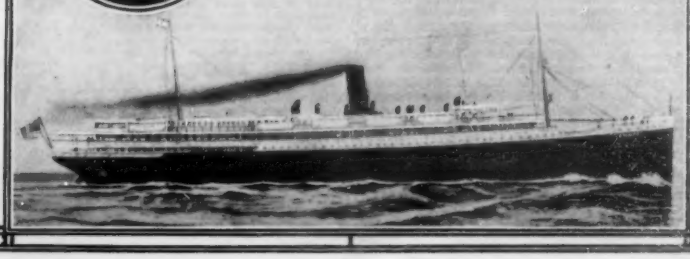

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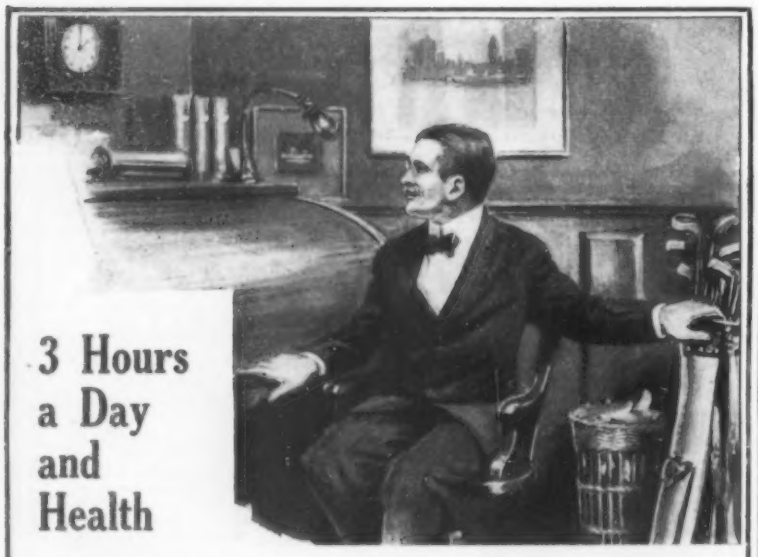

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BULGARIA AND HER PEOPLE. With an Account of the Balkan Wars, Macedonia, and the Macedonian Bulgars. By Will S. Monroe. Boston: The Page Company, 1914. 8vo.; 410 pp.; illustrated. Price, $3 net.

This is another of Prof. Monroe's sympathetic studies of out-of-the-way places and peoples. It is the first book of the kind in English to deal with the new Bulgaria, a country that has made most wonderful recent progress in most of the arts of peace. The author has—so he puts it—"stressed the human side of the subject." These people have an art and literature of surprising merit and virility. The former is well represented by Mirkvicka, the value of whose work is indicated even in the photographic reproductions of Prof. Monroe's volume.

ARITHMETIC. Book I. Fundamental Processes. Book II. Practical Applications. By John H. Walsh, Assistant Superintendent of Schools of the City of New York, and Henry Suzzallo, Teachers' College, Columbia University. Boston: D. C. Heath & Co., 1914. Book I, 35 cents. Book II, 65 cents.

The most urgent demand now made regarding instruction in Arithmetic is that (1) fundamental processes shall be emphasized in the lower grades in order that efficiency may result; (2) that the social and economic applications of arithmetic shall be taught in the upper grades, so that grammar school children will have an insight into the typical practices of modern life. These books meet both requirements to an exceptional degree. The series is so arranged that a pupil may acquire an easy and accurate command of the processes by the end of the sixth year. The seventh and eighth school years are thus left free for the study of practical applications. No books heretofore offered to schools contain so varied and extended a series of applications of arithmetic suitable to the conditions of modern life such as the rank and file of pupils are likely to meet.

COLLEGE PHYSIOGRAPHY. By Ralph Stockton Tarr, Late Professor of Dynamic Geology and Physical Geography in Cornell University. Published under the editorial direction of Lawrence Martin, Associate Professor of Physiography and Geography in the University of Wisconsin. New York: The Macmillan Company, 1914. 8vo.; 837 pp.; illustrated. Price, $3.50 net.

"College Physiography" meets the requirements of college and normal schools, furnishes a supplementary reader to students of more elementary texts, and is also adapted for general reading. It presents the geographical features of our world, cites processes and topographic forms, treats of the physical geography of the ocean, and explains atmospheric effects. The interest is sustained by connecting all these aspects with their bearings upon human life. Certain omissions are suggested where an abridgment is desirable. The ten colored maps, an important feature, have been carefully selected. All the subjects of study are generously illustrated by photographs and diagrams of a high order of merit. The reputation of the late Prof. Tarr is fully upheld by this volume, which was left uncompleted by his death. To Prof. Martin must go the credit of the last seven chapters and the casting of the entire work into efficient textbook form.

PITMAN'S MANUAL OF SPANISH COMMERCIAL CORRESPONDENCE. By G. R. Macdonald. New York: Isaac Pitman & Sons. 12mo.; 328 pp.

The Manual offers a large collection of letter forms both in Spanish and English, with explanatory foot notes. There are also various market reviews and financial reports. An English-Spanish vocabulary gives more than 3,000 terms relating to numerals, colors, textiles, countries, and technical and mechanical terms, and is supplemented by a briefer Spanish-English vocabulary. The wording in the correspondence forms in English is occasionally awkward or redundant, but this does not seriously impair the value of the work to the exporter. Although there is a table of contents, an index, if only inclusive of the letter forms, would have facilitated reference, since more or less overlapping of subjects is unavoidable. In view of our present relations with Spanish-speaking peoples, and of our enlarging prospects in this direction, the manual should prove distinctly helpful to exporters and their correspondents.

THE AMERICAN BOY'S WORKSHOP. Each Subject by an Expert. Entirely Rewritten and Edited by Clarence B. Kelland of "The American Boy." Philadelphia: David McKay. 8vo.; 339 pp.; illustrated. Price, $1.25 net.

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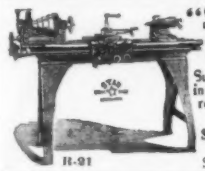

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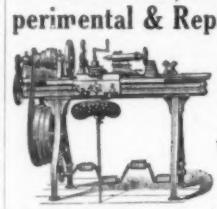

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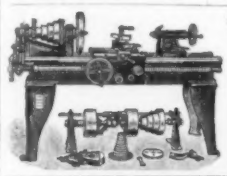

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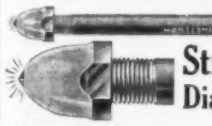

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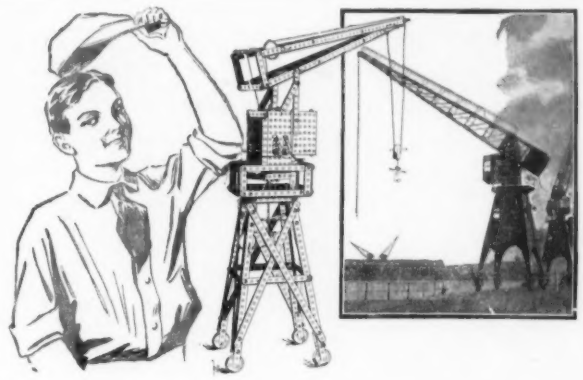

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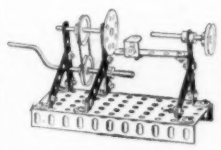

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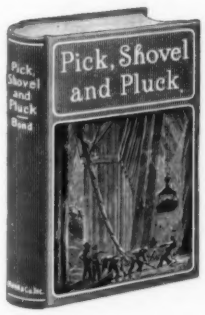

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